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Our poor friend the horse seems unable to keep pace with urban developments. During the summer our sympathies are aroused on his behalf whenever the temperature becomes uncomfortably warm, and during the winter we feel for him on account of the cold. On the other hand, the automobile runs along, not caring for weather changes, and its immunity, by comparison, intensifies our pity for the beast. Then, too, city improvements call for better, smoother street pavements, and a slight fall of snow or sleet makes it almost impossible for the poor horse to get along; and, as a consequence, he delays and blocks traffic by mechanically driven vehicles of all descriptions. We may feel great satisfaction because the horse-car has disappeared almost completely within the past ten or twelve years, but it is to be hoped that during the next ten years a similar change will take place in the method of propelling all business vehicles. The horse is certainly ill-suited to our present city life.

THE OPPORTUNITY OF THE ERIE RAILROAD.

The Erie Railroad Company controls a number of railway lines traversing one of the most desirable localities for suburban homes within reach of New York. It has spent thousands of dollars in advertising the advantages of this section of New Jersey, and it has induced thousands of people to move there; and one would imagine that the company would make every effort to satisfy its patrons, for certainly one commuter on the line is worth two prospective commuters in the city. An examination of the Erie train schedules would lead the examiner to believe that this effort was being made; but from those who travel on the road one hears nothing but complaints. It is said that the trains are never on time. During the severe cold weather the cars can not be heated, and frequently no attempt is made to run trains that are scheduled. These conditions have prevailed every winter, but this winter they have been worse than ever, due, no doubt, to the giving out of the old locomotives and to the extreme severity of the weather. Matters have come to such a pass that mass meetings have been held in several towns, demanding a better service; and the officials of the road have replied by taking off twenty-nine trains. This, they say, will relieve the congestion at the Erie terminal and allow trains to enter and leave on time. It will also enable better equipped trains to be run, and breakdowns will be less frequent.

The Time to Electrify.

Whether this move will satisfy the suburban resident we do not know; but the apparent condition of the motive power of the road suggests that this is a most suitable time to begin electrification. It is evident that new locomotives must be purchased. Why not decide upon electric locomotives? It is estimated in a recent paper by Mr. A. H. Armstrong that the alternating-current system of electric traction is not only cheaper to operate than steam, but the saving in expense pays a handsome profit on the cost of the equipment. This reason alone should be sufficient to make a decision in its favor. But examine for a moment the other benefits which would be secured: a faster and more frequent train service could be maintained. The dread of tunnels would disappear, and the trains would be clean and free from smoke. How could parallel roads operated by steam compete with the electric trains of the Erie, or how could the trolley lines, making at best an average of from twelve to fifteen miles an hour, compete with an electric train running at a schedule speed of thirty or forty miles an hour? Would not a decision to electrify the suburban lines of the Erie not only retain all the present residents, but do more toward building up this business than all the money which has been spent for this purpose up to this time? It seems to us as if this were the psychological moment to decide upon electrification.

HOIST BY HIS OWN PETARD.

An instructive incident occurred recently at a railway power station in Cardiff, Wales, when a disgruntled workman who had been discharged attempted to wreak vengeance on his former employer by crippling the power-house. Unseen by the watchman, he gained access to the room below the switchboard, in which were placed the regulating rheostats for the field circuits of the generators. He knew that if he opened the field circuits of the generators they would cease to operate; but he evidently knew little about the laws of electromagnets, and his little knowledge came near being his death. His first attempt to disconnect a field circuit was, unfortunately for him, successful—unfortunately, because he was probably very careful in this case; but that particular generator was not running. His next attempt was also successful, so far as opening the field circuit was concerned; but the second generator was in operation, and either because the would-be station wrecker had become careless since nothing dreadful happened in the first case, or perhaps because he didn't know any better, he received the entire discharge of the field circuit through his body. The generator immediately stopped work, but so did the station wrecker, and he was found soon after by the station attendant unconscious and badly shaken up. Happily for himself he was not killed, though he has now to stand a charge of attempting to destroy property.

Little Knowledge His Undoing.

This is an excellent illustration of the danger of a little knowledge. A day laborer would probably have kept away from the wires entirely, or have attempted to break them by throwing something against them. But this man had run wires for lamps, and, no doubt, in his opinion, was well versed in electrical science. He receives the reward for his temerity in the form of aching bones and a probable legal punishment. Attempts to interfere with the operation of electric stations are, fortunately, rare, due, no doubt, in some measure, to the wholesome respect entertained by the layman for all things electrical, a respect which, indeed, is shared as well by the expert.

CAR HEATERS.

A correspondent of one of the New York dailies believes that electric heaters are inferior to steam, because, as he puts it, the generation of heat by electricity is inadequate properly to heat a car on even moderately cold days, as well as being very expensive. Moreover, he says, that what heat is supplied by electricity is all forced from the car when the train approaches a station, by reason of both doors of the car being opened several seconds before the train is brought to a stop. In the latter respect, there is no reason for believing that air heated by steam is any more stable than that heated by electricity; and to heat a car properly is only a question of supplying current enough to the heaters, and furnishing a sufficient number of heaters to the car. Given the same amount of heat units, supplied to the car as electric current and in steam, the electric heater should be more effective, as by suitable design, it can be operated at any temperature, while the temperature of steam pipes must be approximately that of the steam.

ELECTRIFYING THE STEAM LOCOMOTIVE.

One of our foreign contemporaries gives in its current issue a brief description of a traction system which it states is now being considered by railway officials of Switzerland, whose lines are at present operated by steam. As Switzerland has no coal mines, these railroads are entirely dependent upon imported coal, which is not only expensive, but the supply is not always certain. Switzerland has, however, numerous waterfalls available for power purposes, and for some time past plans for utilizing certain of these falls for the purpose of operating her railroads have been discussed, and, indeed, some progress has been made toward their development. However, to transform the entire system of railways into electric would not only involve an enormous expense and necessitate the condemning of the steam locomotives and possibly a good many cars, but it would require a considerable amount of time to effect the conversion. The new system which is now being investigated seeks to avoid much of this expense and delay by retaining the steam locomotives. The use of coal is to be abandoned, and steam is to be raised by electric heaters placed in the locomotive boilers. This can be done without much expense, with but little change in the locomotive, and the addition of a few indicating and controlling instruments in the locomotive cab, and but little instruction will be needed to enable the present locomotive crews to handle their machines safely.

Is the Scheme Feasible?

On first thought the suggestion seems absurd. Electrical energy is to be generated and distributed to the railroads, and is then to be degraded into heat and used in an inefficient machine. But it may be that there is enough water power available to make the enormous loss, due to the inefficiency of the system, insignificant, and the scheme might do as a temporary expedient. The cost for the electrical energy at current prices might not be more than the interest on the electrical equipment, and if the water power can not be used in other ways, the waste of energy is not a permanent loss. On the other hand, while the electrical energy can be distributed to the trains cheaply enough, the inefficiency of the locomotives would probably make it necessary to deliver to them at least ten times as much energy as would be required by an electric locomotive, and of course the generating station and the line would have to be built with a view to meeting this condition. It is true that the station and line would be available when the electrically heated steam locomotives were replaced by electric motors. A railroad power station must, in general, operate under unfavorable conditions, and these would not be much improved by the plan proposed, although the demand made by each locomotive on the station would be less variable than that of an electric train, as the heaters would be on all the time. A careful investigation may convince the officials that the system proposed is feasible, but this hardly seems likely. It may prove to be an instance where good enough is best, and therefore good engineering; but one can not help feeling that there should be a better solution.

EXPERIMENTS ON EDDY CURRENTS.[1]

BY W. M. THORNTON.

I—EXPERIMENTS ON MASSIVE CAST-IRON AND STEEL RINGS.

The increased loss due to eddy currents at full load depends very much on the construction of the machine. It is greater with poles and pole-faces of high electrical conductivity than with cast iron, because the circulation of the local eddies varies not only inversely with the specific resistance, but as the square of the permeability. It is for this reason that they are much greater in iron than in copper, for the ratio μ^2/ρ is 500,000 times greater for the former than the latter at ordinary flux densities. A comparatively small variation of magnetization will therefore give rise to strong currents when they are permitted to flow.

Before examining in detail the losses in a machine, it is well to know how eddy-current loss is related to hysteresis and copper losses in the most perfect case—that is, of a massive closed iron ring covered with a uniform winding and excited by an alternating current. For this purpose it is only necessary to measure the current taken and watts absorbed by the coil under different conditions of excitation and at different frequencies. Tests were made on two yoke rings, the hysteresis loops of which have been determined by a special method independent of the influence of eddy currents in the core. Each ring was connected in turn first to the supply mains at a frequency of eighty-three, and then to experimental alternators giving either eighteen or thirty-seven periods per second.

When the frequency is high it is impossible to work out the hysteresis loss from loops obtained by a slow cyclic process, but when the magnetization is less than saturation the eddy-current and hysteresis losses can be separated by considering the latter to be proportional to the rate of change of the induction—that is, for low values to the exciting current—and the former to its square. Thus, if w represents the total watts less the copper loss it can be written

$$w = a\,i + b\,i^2,$$

where a is the watts lost by hysteresis per ampere and b those lost by eddy currents per (ampere)^2. a and b can be found from two readings:

$$w_1 = a\,i_1 + b\,i_1^2,$$

$$w_2 = a\,i_2 + b\,i_2^2;$$

so that $$a = \frac{w_2\,i_1^2 - w_1\,i_2^2}{i_1\,i_2\,(i_1 - i_2)},$$

and $$b = \frac{w_1\,i_2 - w_2\,i_1}{i_1\,i_2\,(i_1 - i_2)}.$$

At the higher frequency the greatest value of b for the steel ring is twenty-five watts per (ampere)^2, and of a 31.6 watts per ampere, but these coefficients vary with the saturation, and should be determined from adjacent values for the whole range of excitation.

Much difficulty was experienced with the cast-iron ring in getting consistent readings. This was found to be due to the retentiveness of the iron. The highest alternating voltage available in the laboratory is 100, and not having a suitable transformer the greatest current reached at the highest frequencies was 0.67 ampere. The power-factor was found by the oscillograph and the watts calculated, but there is little practical interest in these very low magnetizations. Typical oscillograms are given in curves I and II (Fig. 1).

It is interesting to compare the behavior of the two rings. The area of the iron ring is 2.25 times that of the steel. Its permeability is about one-half; the ratio of the turns on the windings is as 1.285 to 1. The inductance of a coil with a laminated core being

$$L = 4\,\pi\,T^2\,A\,\mu/l,$$

where T is the total turns, A the cross-sectional area of the core, μ its permeability, and l its mean length, the corresponding inductance of the iron ring is 2.84 henries, which is 1.44 times that of the steel. The resistance of the "iron" coil is 2.9 ohms, that of the steel 1.9. These are too low to affect the impedance, and the inductance would with laminated cores be in the ratio of 1.44 to 1. They are actually 5 to 1.

TABLE I.

—	Cast Iron.	Cast Steel.
Mean permeability from loops.	$\mu_1 = 260$	520
Calculated inductance	2 84	1.98
Observed impedance	149	30.58
Resistances of windings	2.9	1.9
Frequency	83.5	83.5
Observed inductance	0.445	0.058
Actual permeability of cores as a whole	$\mu_2 = 40$	19.8
Ratio μ_1/μ_2	6.5	26.3
Frequency	37	13.3
Observed impedance	132	18.1
Observed inductance	0.57	0.034
μ_2	51.5	11.7
Ratio μ_1/μ_2	5.05	44.5

Table I shows how the cores are affected and their magnetic properties inverted by the action of the eddy currents.

Cases of solid cores exposed to alternations of this kind are rarely met in practice, but it is common to find a solid frame-work carrying a flux density less than saturation exposed to alternations of rapid frequency and considerable amplitude, as, for example, in the magnetic circuits of alternating-current machines. Some effects of these oscillations have been given in a former paper, and the tests made on the Hastings plant show that they are present under the best conditions of practical working. To imitate such cases, I placed an alternator in series with a continuous-current generator across the coil windings, obtaining curves III and IV (Fig. 1). In the larger of the two with 100 volts alternating superposed upon 100 volts continuous, the effect of the core in distorting the voltage wave is seen as a third harmonic. The current variation has an amplitude of about twelve per cent of the mean reading and seventeen per

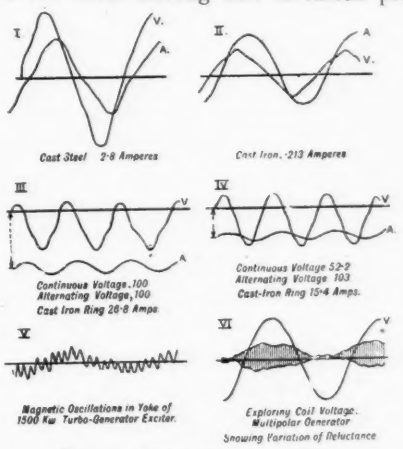


FIG. 1.—OSCILLOGRAM CURVES.

cent when the continuous voltage is reduced to fifty. The maximum disturbances of field currents observed in practical working were twenty-two per cent of the steady value in single-phase, fifteen per cent in three-phase machines, the average being about ten per cent. The ring experiments (table II), therefore, closely approximate to the conditions of practice, and it may with reason be inferred that the losses will be in much the same ratio and of the same order of magnitude in similar yoke rings and magnet cores.

To separate the continuous from the alternating-current components, the oscillograph records were necessary. The ammeter reads $\sqrt{(I + i\sin\theta)^2}$, and by knowing the relative values of i and I from the curves, their average values can be separated. Thus when the ammeter read 26.8, twenty-four was continuous and 4.08 alternating. The combined voltage was taken with an electrostatic instrument. It is seen that the intensity of the continuous magnetization is so great that the hysteresis loop is closed for the range of

[1] Paper read before the Newcastle local section of the British Institution of Electrical Engineers, December 14. Abridged from the London *Electrician*.

TABLE II.

Continuous Voltage.	Alternating Voltage.	Combined Voltage.	~	Amperes.	Watts.	Cos ϕ.
52.2	103	112	86	15.4	853.4	.485
100	100	138	86	26.8	2,410	.65

H Continuous.	H Alternating.	Hysteresis Watts.	$r\,i^2$.	Watts Eddy Current.	Per Cent.	Eddy-current Watts per c. c. of Core.
89.6	10.4	3.5	690	180	12.1	.055
156.2	26.6	0	2,080	230	13.6	.101

alternating current employed. There is, nevertheless, a wave of magnetization accompanying each reversal of the alternating component, which, though the permeability is comparatively small, still entails a certain loss in the core, amounting in the second case of table II to 330 watts, or 13.65 per cent of the whole energy dissipated, and in the second case, when the permeability is slightly greater, to twenty-one per cent.

II—TESTS OF CONTINUOUS AND ALTERNATING-CURRENT MACHINES.

From these results it can be concluded that if in any machine the field current shows a synchronous variation, caused by armature reaction, of about ten per cent, there will be a loss in the core by eddy currents which will be a large fraction of the total losses in the machine.

In the experimental machine tested the total volume of the two magnet cores and yoke is 30,000 cubic centimetres, all of which is exposed to varying magnetization, though not of the same amplitude. Running it as a shunt motor, light, and varying the speed, the eddy-current loss at 1,150 revolutions per minute is found to be 480 watts. Now, the energy lost in an iron core varies as the square of the alternating ampere-turns applied to it, but the secondary voltage in an exploring coil about the core is proportional to the primary ampere-turns. By measuring the exploring coil voltage under various conditions of working, the magnetic movements producing eddy currents within the core can be gauged. A few results were obtained in this way by means of a hot-wire galvanometer placed across the series turns. When the brushes were central, very little deflection was observed. They were, therefore, moved backward until commutation took place in the fringe from the trailing tip and slight sparking was visible. They were fixed in this position during the tests. The disturbing influence of the armature current was seen by the great increase in the square of the ratio of deflections with load when the fields were weakened. The deflection obtained when the machine was running light as a motor with the brushes forward to the same angle that they were previously backward was $\theta_0 = 8.2$, with an armature current of nine amperes. The figures in the last column give the relative eddy-current losses in a loaded generator to those in a motor running light, which are given above.

It is difficult to imagine a loss of 2,300 watts by eddy currents in a ten-kilowatt machine even with the brushes far backward. The last column of figures must stand for what it is worth as a test of the method, but it was thought well to devise another, and the method finally adopted was to pass an alternating current through the series windings and to measure the power at different currents or frequencies. See table III.

TABLE III.

Volts.	Amperes.	Watts.	Cos ϕ.	I. T.	$r\,i^2$.	Eddy Current Watts.	Hysteresis Watt.	Ratio Eddy /Hysteresis.
86	41.4	2,300	.64	4,554	69.8	1,975	255	7.7
56.8	26.2	900	.60	2,882	28.0	790	82	9.6
43	17.75	468	.61	1,952	12.8	363	92.2	3.9
25.5	11.9	220	.72	1,310	5.6	163	51.4	3.18
18.25	8.05	115.5	.78	885.5	2.6	74.5	38 4	1.94
12.1	5.27	50 2	.78	579.7	1.1	31.9	17.2	1.85

Applying the previous method of separating hysteresis and eddy-current loss, the three components have been worked out. It is reasonable to suppose that in this case practically all the eddy currents circulate in the solid frame, for it is certain that those in the laminated armature are exceedingly small compared with the circulation in the solid core around which the magnetizing coil is placed. According to this table, it takes about 2,000 ampere-turns applied to the coil at a frequency of eighty-three to produce eddy-current loss comparable with that observed in a motor running light, but since the loss varies as the square of the frequency, it would take only 13.8 ampere-turns to produce the same effect at a frequency of 1,000, which is that of commutation. It may be pointed out that the loss in the solid frame—*viz.*, 480/30,000, or 0.016 watt per cubic centimetre—is not widely different from that obtained in table II, from the experiments with alternating currents on cores already saturated.

III—OSCILLOGRAMS OF MAGNETIC FIELD DISTURBANCE BY VARIATION OF ARMATURE REACTION AND RELUCTANCE.

It has been shown that large eddy-current loss can take place in the magnet frames of both continuous and alternating-current machines. In the latter class the chief source of the loss is, no doubt, variation of armature reaction; but in the former the conditions have been generally thought to reach a steady state, or one in which the magnetic movement is confined to the armature teeth or pole-faces.

There are in continuous-current machines four possible sources of disturbance; the first and most important at light load being imperfect centering of the armature or adjustment of the air-gaps. The second is the variation of reluctance caused by the teeth of the armature moving across the pole-face. The third is the slight peripheral shift of the cross-magnetizing belt to and fro during commutation; and the last the variation of reaction set up by a rise and fall of armature current, caused by phase swinging or uneven turning moment of the engine.

(To be continued.)

Class of 1893, Massachusetts Institute of Technology, Boston, Mass.

The class of 1893, Massachusetts Institute of Technology, has issued its fourth and decennial catalogue. This contains a short contribution by President Henry S. Pritchett, discussing the institute's present position and its future problems, with a brief account of the changes brought about in ten years. The greater part of the catalogue is given up to a record of the members of the class.

These catalogues are of great interest to not only the alumnus, but also to the outsider.

CARE AND MAINTENANCE OF STORAGE BATTERIES—II.

BY EDWARD LYNDON.

BUCKLING.

Primarily buckled plates are caused by unequal current densities on different portions of the same plate and by excessive formations of sulphate. That there are numbers of causes which contribute to the condition of unequal current densities is evident.

First—This may come about in the manufacture of the plates, where more active material is put on one side of a plate than the other, or the character of the active material may be different on different portions of the plates, or differences in the formation of the plate may give rise to all the conditions necessary to buckle. However, there are comparatively few buckled plates that can be attributed directly to the process of manufacture, and the cause will usually be found elsewhere. Local action may discharge a portion of a plate, forming sulphate in patches or spots, and provided this affected area penetrates the plate to any depth, until it is in an irreducible state, this portion will become worthless, and in addition to doing no work will result in different current densities on the plate tending to distort it. This applies with equal truth to plates that are continually discharged to such an extent that deep and excessive sulphate is formed, and if this sulphate is not uniformly reduced over the entire plate on the following charge there is a tendency for such plate to buckle. More buckled plates probably result from this excessive discharge than from local action, as the formation of sulphate by local action is more or less a self-limiting action, for as soon as the active material in contact with the substance causing local discharge is turned into sulphate, there ceases to be any further action and the affected area is small.

Excessively high rates of discharge can readily cause buckling, due to the fact that the current can not distribute itself over the plate surface uniformly. This is true of course with normal rates, but in this case there is sufficient metal in the body of the supporting and conducting element to distribute the current fairly well, and the drop between the conducting lug and the furthest portion of the plate is too small, when working within the maximum normal rate, to cause appreciable differences in current density in different portions of the plate.

If, however, plates are subjected to excessive charge or discharge rates the difference of resistance from the conducting lug to different portions of the plate will result in varying current densities over the plate surface and this will cause unequal action.

A buckled plate, however, is not a source of trouble unless it has buckled to such an extent as to come in contact with other plates in the cell. Some plates after they have been in service for a short period take up a position termed their permanent set; that is, they become slightly distorted but seem to keep this set position and apparently no further distortion takes place under normal battery conditions. This is due, evidently, to mechanical strains existing in the plate from its manufacture, and the active service distorts the plate in a direction to relieve the strain.

It appears, however, that this tendency to change from the original straight position would be further augmented with continued action, as the resulting walls of acid on either side of the plate will not be of the same thickness, which changes the resistance, the result being that one side of the plate will do more than its share of work, since the resistance from that side to the next plate has been reduced. So long, however, as a plate of this kind or one slightly buckled is separated from other plates in the cell no trouble will result, and to all purposes the action of the cell is normal in every way.

When plates have become so distorted as to become troublesome, it is necessary to put them through some straightening process; some plates can not be straightened, these of course must find their way to the junk pile and new plates substituted. In the straightening process the pressure should be uniform and applied slowly, the use of blows for straightening plates will send them to the junk pile before their time.

If the buckled plates are of small size and each of the plates making up the element is burned to a cross-bar, flat pieces of wood should be inserted between the plates and boards on the outside, the whole being put in a big letter-press or the like and then the pressure slowly applied.

In large cells, in which the plates are burned to a bus-bar, it will be found necessary to cut out the buckled plates and remove them from the cells. Such plates may be straightened by placing them between two smooth, flat-faced surfaces and the pressure applied by pulling the surfaces together with bolts and nuts.

Buckled plates are easily detected when making inspection, and when buckled so far as to come in contact with other plates at once form an internal short-circuit.

INTERNAL DISCHARGE.

Local action is due to the presence of foreign metals in the electrolyte, and, as before stated, it is to an extent a self-limiting process on account of the conversion of the active material with which the foreign substance comes in contact, being converted into lead sulphate, that is, this spot of active material in contact is discharged, forming the sulphate and thus stopping further action at this point. However, some substances are carried back and forth in the electrolyte with each successive charge and discharge, the cumulative action in such cases may be serious.

For local action to occur there must exist a difference of potential between the two members forming the local circuit great enough to decompose the electrolyte, and it follows that the local action will be greater or less depending upon the difference of potential between the active material and the substance in contact therewith, this will vary of course with different metals, but it is hardly in the province of this article to tabulate the metals in the order of their activeness when in contact with active materials immersed in dilute sulphuric acid. No foreign substance in a cell can help it, and precautions should be accordingly taken to prevent their occurrence. It may be worth while to note that the positive is subject to practically no troubles from local action, the negative plate, however, is extremely sensitive in this respect.

With the present manufacture of plates and with good quality of brimstone acid no particular troubles from local action should be encountered, provided the cells be kept free from all foreign substances. Internal short-circuits may be formed by foreign substances getting into cells and bridging positive and negative plates, or by plates buckling until contact is made with other plates in the cell. Short-circuits may also be formed by dislodged active material wedging between plates or by growths on the surface of the active material which may be sufficiently great to joint two plates electrically. The sediment in the bottom of the jars or tanks may rise to such a height as to bridge positive and negative plates and thus cause a short-circuit. No matter to what source the short-circuit is due, the first remedy is to remove the cause, and if it be due to buckled plates the remedy has already been outlined. If the short-circuit is caused by lodging of any substance between the plates or by growths from one

plate to another, the substance or growth should be removed by means of a strip of wood or hard rubber. If the short-circuit be one of extremely low resistance the passage of current will be excessive, and in some instances has been sufficient to burn away the short-circuit path and incidently those portions of the plate subject to high current flow.

If the short-circuit be one of comparatively high resistance the action on the cell may be very slow and perhaps will not manifest itself for some days. In all cases, however, the effect of short-circuits is to discharge the plates and form sulphate. The most prolific cause of short-circuits is dislodged active material wedging between the plates. Some of the active material may in time break away from the supporting frame because of excessive expansion and if this material lodge between the plates the short-circuit is formed.

Shedding, formation of growths and blistering of active material are due to the combined action of gases evolved on charge as well as to the expansion of the material. If the charge rate be high, the evolved gases are liberated with such rapidity that they urge some of the active material out, and this taken in combination with the weakened structure of the material from continued changes in volume cause it to blister or shed.

(To be continued.)

Sun Spot Changes and Their Dangerous Electrostatic Influences Upon Chemical Explosives and Inflammable Gases.

At the meeting of the New York branch of the Society of Chemical Industry, held at 108 West Fifty-fifth street, New York city, January 22, 1904, a paper by Mr. Edward Durant on the above subject was read. We quote some of the author's interesting conclusions:

"It has long been known that there is an unmistakable (though unexplained) connection between the spottedness of the sun's surface, static or magnetic storms, and the Aurora Borealis or northern lights; and in all these static electricity plays a prominent part.

"These spots are liable to appear at any time of the night or day, and at any time of any year, in a greater or less degree, but we are sure to observe them on an average about every eleven years, when they are at a maximum. They are then liable to last at times from an hour to several weeks or months. Their static influence is much greater during winter months, when a clear atmosphere prevails.

"When sun spots appear in size or numbers sufficient to influence electrostatic effects on this earth, they are liable to disturb all kinds of electrical apparatus in service, without any exception.

"Static electricity is one of the best detonators extant, and it can be readily generated on one's person, under certain conditions, by the mere act of walking. The body is then immediately transformed into a large Leyden jar, fully charged and ready to do mischief just as soon as the hand reaches out to touch the explosive.

"A ship having on board a cargo of chemical explosives or volatile oils from which explosive gases emanate is sailing in a dangerous realm when confronted with that peculiar electrostatic phenomenon known to mariners as St. Elmo's Fire, corposant or Helena, which is an illumination at night of these electric charges or discharges from the tops of the masts, ends of the yard-arms, bowsprit and all points. Their presence is a good cautionary signal warning us against the possibility of an immediate explosion on board if great care is not exercised.

"For example, if we allow the captain's wife to occupy a stateroom in close proximity to where explosive gases are emanating from a cargo of volatile oils, she will generate considerable static electricity the moment she combs her hair; and if the mixture of air and gas is in the right proportions, the sparks from the rubber or celluloid comb are liable to cause an explosion; and we all know what the result will be.

"A cat's back, no doubt, is highly electric during these disturbances of the sun, and it is reasonable to assume that if a cat went through a comparatively small hole quickly, while in pursuit of a rodent, the rubbing of his back on the top of the orifice would generate considerable static electricity, which would be liable to explode gases. All this suggests the advisability of having only short-haired men, women, children, cats and dogs on board such ships, or anywhere in proximity to explosives.

"The scope of electrostatic influences is wide. It includes botany, and the following information might lead to one obtaining a good automatically electrostatic sun spot signal device.

"The carnivorous plant commonly known as the Venus flytrap (*Dionæa muscipula*) closes its trap immediately it is placed in a strong electrostatic field, and it soon returns to its normal position when relieved from this static influence.

"Possibly by cultivation botanists will be able to produce these plants much more sensitive to this peculiar influence, when they will be of great value by virtue of their signaling to us automatically the presence of that highly interesting force known as static electricity."

The Independent Telephone Association of Wisconsin.

The annual convention of the Independent Telephone Association of Wisconsin will be held at Milwaukee, Wis., on February 10 and 11. The Wisconsin association is one of the strongest of the state organizations, and its meetings have always been very successful. The question of an independent exchange in Milwaukee will be taken up and plans formed for carrying out the enterprise. Other matters of importance to Wisconsin companies will be discussed, and an effort will be made to secure the cooperation of all companies in the state dealing with these problems.

A number of prominent telephone men from neighboring states will take part in the proceedings.

Telephone manufacturers and supply houses are making arrangement to exhibit apparatus.

The convention headquarters will be at the Hotel Pfister, and the sessions will be held in the hotel convention hall.

The officers of the association are Richard Valentine, Janesville, president; H. G. Slater, Waupaca, vice-president, and H. C. Winter, Madison, secretary and treasurer.

A Fine Exposition Calendar.

The passenger department of the St. Louis & San Francisco Railway has prepared a splendid art calendar, presenting in allegorical illustrations the development of the Louisiana purchase. The illustrations are in color and are well executed. The calendar background is a reproduction of bas-relief in gold. On the back of each leaf of the calendar is the historical relation of the illustrations. This calendar is published for the benefit of the "Frisco system." In addition to the calendar there is a sheet showing the details, in colors, of the official ground plan for the World's Fair, and a map of the city of St. Louis, showing the street car lines and location of the fair grounds. There is also a map showing the outlines of the Louisiana purchase from France in 1803, and the Frisco and Rock Island systems.

INDUSTRIAL ELECTROCHEMISTRY AND ELECTROMETALLURGY—IX.

NOTES OF PROGRESS IN EUROPE AND AMERICA.

BY JOHN B. C. KERSHAW.

Electrolytic Alkali and Bleach Processes in the United States.

E. Hart in a paper prepared for reading before Section II of the Berlin chemical congress in June, 1903, and printed in the advance reports, gave some very interesting figures and details relative to the progress of the electrolytic bleach industry in America; and the following abstract of the electrochemical portion of Mr. Hart's paper will doubtless prove of value to some of the readers of the ELECTRICAL REVIEW.

The Castner Electrolytic Alkali Company is stated to have had 540 cells operating up to April, 1902, and to have increased the number to 1,620 since that date; 162 cells of this total being always stopped for repairs, etc. The aggregate output of the 1,460 cells in constant work is thirty tons of caustic soda and sixty-six tons of bleach per day.

The Acker Process Company commenced manufacture in 1899 with forty-five cells, and is understood to have increased its plant since that date. The present estimated production is, however, only five tons of caustic soda and eleven tons of bleach per day. This company has had much trouble with the Niagara board of health, owing to escapes of chlorine, but Hart states that after much expenditure of time and money the chemists of the company have overcome this difficulty. The chlorine from the Acker cell, however, is said to be absorbed slowly by lime, and it does not readily produce a high strength bleach.

The American Alkali Company operated 120 cells of the Rhodin type at Sault Ste. Marie from January, 1901, to September, 1902, but the works were not a success financially, and the plant is now shut down.

The Dow process at Midland, Mich., is reported to be producing chlorine by electrolysis of a natural brine, in a diaphragm type of cell. In the Dow cell ferric hydrate functions as the diaphragm, the formation of this product being due to the reaction between ferric chloride and sodium hydrate. The ferric chloride is produced in the cell by the action of free chlorine on iron. The caustic hydrate produced in this process is run away as a waste liquor, only the chlorine being utilized, and this plan is said to be followed in several of the American electrolytic bleach works. The plant at Midland was doubled in 1902, and it is now stated to be producing forty tons of high strength bleach per day. Steam power is used for generating the electric current.

The Le Seuer process and cell, started at Rumford Falls in 1894, is another diaphragm process. It was operated for many years with moderate success, but according to Hart the plant at Rumford Falls has been stopped, and the Le Seuer cell is now only used for producing hypochlorites for bleaching purposes in a number of small pulp mills.

The Roberts Chemical Company is stated to be using 500 horse-power in 100 cells of the Roberts type at Niagara Falls for electrolysis of potassium chloride. The anodes and diaphragms of this cell are of peculiar structure and materials, anthracite coal and silicate of soda being the chief constituents of these parts of the cell. The chlorine from the anode compartment of the cell is burned with the hydrogen produced at the cathode, and pure hydrochloric acid is obtained in this way. Hart states that this factory is not yet a commercial success. The paper closes with statistical tables showing the growth of the alkali and bleach industry in America, as reflected by the diminishing imports of these two chemicals from Europe. The paper was read by Mr. G. D. Plunock, of Syracuse, at the session of Section II, on Thursday, June 4, but the writer, though present in Berlin, was unable to attend this meeting and he is unaware whether any discussion followed the reading of the paper.

Steel Production by the Heroult Process.

The well-known French electrochemist, P. Heroult, has contributed to a recent issue of *Electrochemical Industry* an illustrated article upon electric steel production by his own process, which deserves attention and comment. The writer had the pleasure of meeting and conversing with M. Heroult, in Berlin, in June, 1903, and he then learned personally that some portion of the power at Le Praz, in France, was being applied to the electrometallurgical production of steel from waste scrap and pig iron. At that time M. Heroult was unwilling to allow details of his procedure to be published, but doubtless the fact that every other inventor and experimenter in this branch of electrometallurgy has followed exactly the opposite policy has caused M. Heroult to repent of his attitude, and has led him to publish a very interesting, though short, description of his experiments and results at Le Praz in an American journal.

The early trials for the production of steel in the electric furnace at Le Praz, in 1899, arose out of the design of a new form of furnace for making ferrochromium alloys; the special feature of this furnace being the use of two carbon electrodes, from which the current passed to and from the molten metal. The furnace itself thus became simply a container for the molten metal, and ceased to function as one electrode for the current. The only difficulty in working this type of furnace was the regulation of the arcs, and this difficulty was overcome by Heroult by use of a third or subsidiary electrode. The form of this furnace used for steel production is covered in and is built on rockers, so that its contents may be discharged by simple tilting, an hydraulic ram being used for this purpose. Originally the cast iron used for charging this refining furnace was also produced by an electrothermal process, 250 tons having been smelted from the ore at Le Praz. But this preparation of the raw material for tool steel has been given up, and all the surplus energy and power at Le Praz are now devoted to the more important and profitable conversion of pig iron into tool steel. Scrap iron either alone or mixed with pig iron, preferably in the molten state, is charged into the furnace just described, and is covered with a layer of artificial slag. It is then submitted to the action of the two arcs, and the slag is used to "wash out" the impurities of the raw iron. The slag first placed in the furnace may be poured away, and a second layer of slag or flux of different composition, if so desired, placed over the molten metal. By adding carbon and other ingredients perfect deoxidation can be obtained, and according to Heroult the steel made by the process holds the record for purity. The aggregate amount of steel made by the Heroult process up to date is stated to be 1,500 tons, of which 300 tons were produced in Sweden by the Aktiebolaget Heroult Elektriska Stal. The process is also about to be adopted at a large ironworks, where the electrical energy will be generated by a gas engine, using blast-furnace waste gases. (This is a speedy fulfilment of the writer's prophecy, contained in the note on electric iron and steel processes, published in the ELECTRICAL REVIEW of January 9, 1904.) The present output of steel by the Heroult process in France is six to seven tons per day, and about the same amount is being produced in Sweden. When the new plant operated by blast-furnace gases is completed, the output is expected to reach 150 tons per twenty-four hours.

The New Station at Dartmouth, England.

By Frank C. Perkins.

IN THE southern part of England, near the coast, a new electric light station has been installed on the river Dart by the Urban Electric Supply Company, Limited, of Dartmouth. The resident engineer at Dartmouth is Mr. G. E. Smith, while the consulting engineers and contractors for this installation are Messrs. Edmundson's Electricity Corporation, Limited, of Westminster, London. The boiler plant consists of two Babcock & Wilcox boilers, having a heating surface of 2,436 square feet, fitted with superheaters of 280 square feet, together with two Halls compound pumps. The boiler room is also provided with a Chevalet Boby heater detartariser. The engine room is illustrated in Fig. 1, and is equipped with two Belliss & Morcom compound engines, having a capacity of 270 brake-horse-power. Each of these engines has directly coupled to it and mounted on the same base a Parker bipolar direct-current dynamo. These machines were constructed for a capacity of ninety-five kilowatts and supply a continuous current of 530 volts. The balancers and boosters are also Parker machines, which are coupled to a common shaft, as noted in the background in illustration, Fig. 1. These machines were installed by the Edmundson's Electricity Corporation, Limited, London, while the switchboard and battery panels were supplied by Charringtons. The main switchboard at the Dartmouth electric station is shown in Fig. 2, and consists of seven panels, two of which are held in reserve for mounting the instruments and switches which may be necessary as the plant is enlarged. The wattmeters are mounted near the base of the switchboard, and above them the various switches and ammeters, voltmeters and rheostat wheels, together with two main circuit-breakers, as noted at the left.

The Dartmouth plant is provided with a storage battery installation as shown in Fig. 3, consisting of twenty-one-plate elements mounted in glass cells and placed on separate insulated bases. The accumulators were furnished by the D. P. Battery Company, and are utilized as a reserve, for regulation and for taking care of the peak of the load.

The boiler plant has been equipped with Meldrum mechanical stokers, of the Koker type. The south end of the building is mostly constructed of corrugated iron to allow for extension, as all of the northern side is taken up by the necessary offices, test room, stores and workshops, and provision has been made for an economizer, which has not as yet been installed.

The Dartmouth station is now supplying 219 consumers with incandescent lighting service, equaling a total of 6,584 lamps of eight candle-power each, with another of fifty consumers equaling 1,200 eight-candle-power lamps to be connected to the distributing mains. The town of Dartmouth is lighted with ten Johnsons & Phillips 1,000-candle-power arc lamps and 150 incandescent lamps of twenty-five candle-power and fifty candle-power each, and also with eight one-ampere Nernst lamps. The Guild Hall and other public buildings are also connected. Submarine cables from the Dartmouth plant are laid

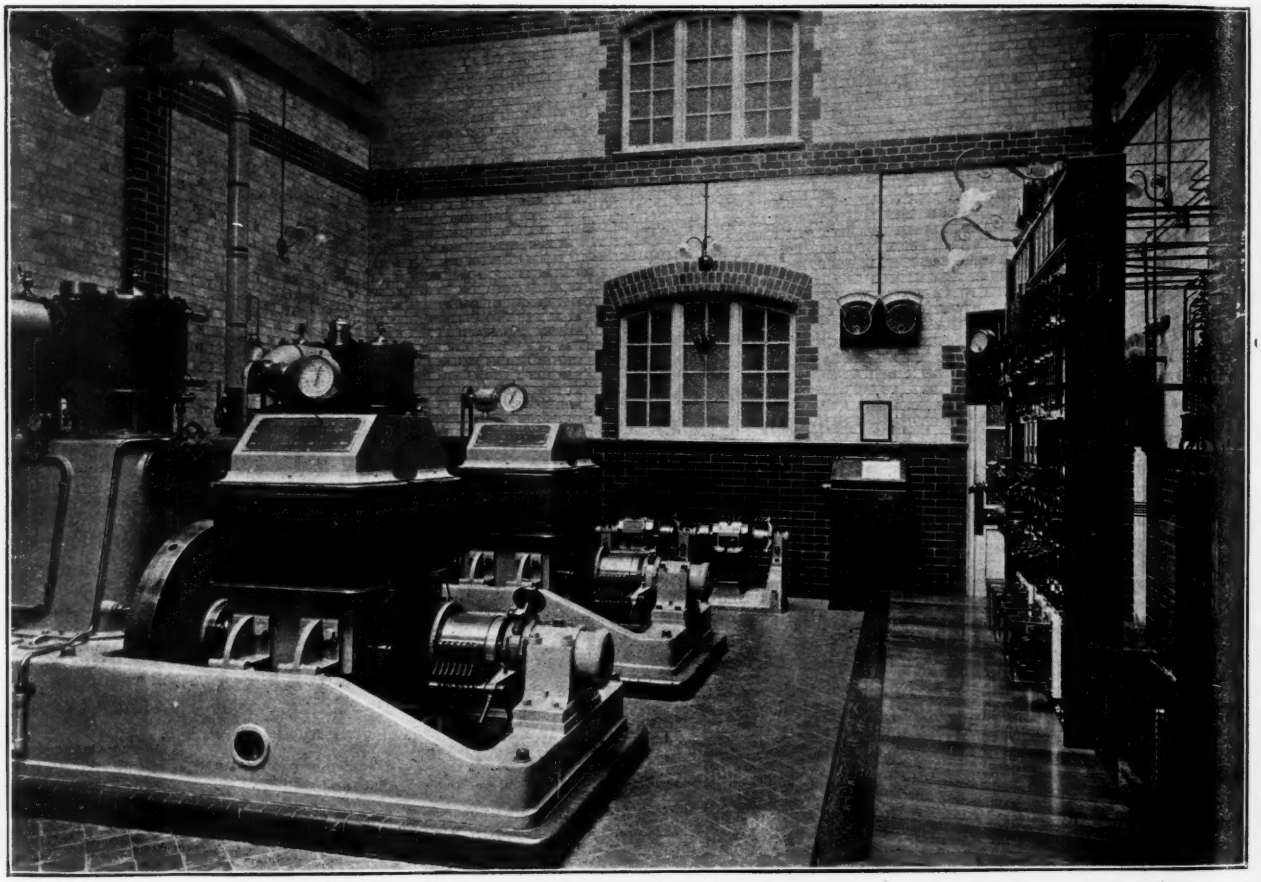


FIG. 1.—ENGINE AND GENERATOR ROOM OF DARTMOUTH ELECTRIC STATION, ENGLAND.

across the bed of the river Dart, the cables being constructed by Callender & Company. The laying of the submarine cables was necessary in order to supply consumers at Kingswear with electric current for arc and incandescent as well as motor service, and also the public lighting which has been secured by the Urban Electric Supply Company, Limited. The new naval college now in course of erection at Dartmouth and about completed will require current for from 7,000 to 10,000 incandescent lamps of eight candle-power each, while the Dartmouth station at the present time is supplying current for a large number of lamps at the new naval hospital. The company wires consumers' premises free of all initial expense, charging a small rental per quarter, and in the smaller houses the company does the necessary wiring free of all cost, supplying the current through prepayment meters. This system, it is claimed, gives every one the opportunity of enjoying the numerous advantages of electric light, and induces a great many to utilize this service who would not go to the expense of wiring their houses if they were required to do so themselves. The prepayment meters ensure the prompt payment for the lighting service, and it is stated that the income has been sufficient to satisfy the corporation for wiring the various buildings at its own expense. It is interesting to note that in England a very much larger number of incandescent lamps are utilized of eight candle-power than of sixteen candle-power, which is also true to a very large extent in the various countries on the continent of Europe, while in America the sixteen-candle-power lamp is standard and is more extensively used than those of lower candle-power.

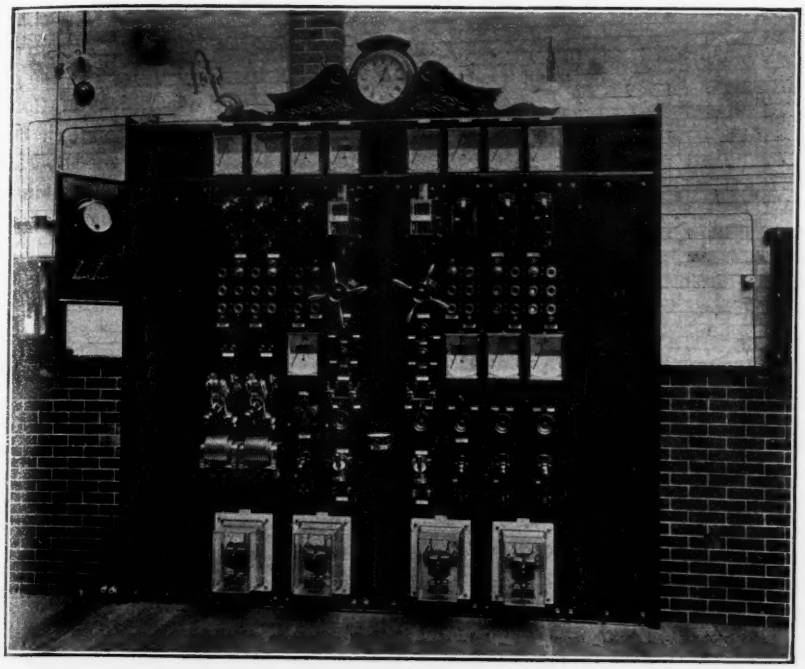


FIG. 2.—SWITCHBOARD AT DARTMOUTH POWER-HOUSE, ENGLAND.

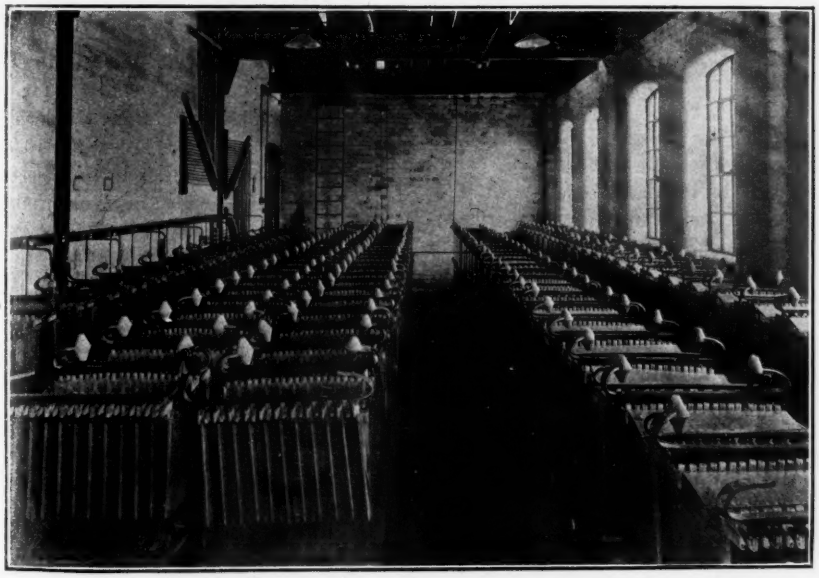


FIG. 3.—STORAGE BATTERY PLANT AT DARTMOUTH STATION, ENGLAND.

It is also interesting to note the fact that in England the bipolar dynamo is still being installed in even the latest light and power stations of small and modern size, directly connected to high-speed vertical engine. This practice is not common in any other country in Europe, while in America the bipolar machine has been almost entirely replaced by multi-polar dynamos. The latest practice in the United States has been to utilize slow-speed engines direct-connected to large alternators and direct-current machines for central station work; although the present interest taken in the steam turbine, its wonderful economy and small space required, may soon bring again into use the high-speed electrical generator, particularly on account of its low cost as compared to the slow-speed machines.

The World's Fair Bulletin for January.

The *World's Fair Bulletin* for January, 1904, published at St. Louis, in the interest of the Louisiana Purchase Exposition, contains a number of interesting articles relating to the progress of work at the exposition grounds. The leading article is on machinery, and is contributed by Mr. Thomas Morrell Moore, chief of the department of machinery. Professor W. E. Goldsborough, chief of the department of electricity, contributes a very interesting article on exhibits in the Palace of Electricity. Transportation exhibits are described by Willard A. Smith, chief of the department, and agriculture is taken up by Frederic W. Taylor, chief of that department. There are other articles on horticultural exhibits, exhibits in the forestry department, mining and metallurgy, by the respective chiefs of the departments, and, in addition to these, there is a large amount of interesting news matter, all of which is supplemented by splendid half-tone illustrations.

BOOK REVIEWS.

"A Treatise on Friction and Lost Work in Machinery and Mill Work." Seventh edition, enlarged. Robert H. Thurston. New York. John Wiley & Sons. Cloth. 442 pages. 6 by 9 inches. 77 figures. Supplied by the ELECTRICAL REVIEW at $3.

This is one of the engineering classics prepared by the late Dr. Robert H. Thurston, and is too well known to need comment. The call for the seventh edition, however, has given the publishers and the author an opportunity to reconstruct the book and bring its contents well up to date.

"The Factory Manager and Accountant." Harris Lucian Arnold. New York. The *Engineering Magazine*. Cloth. 432 pages. 6 by 9 inches. Carefully illustrated. Supplied by the ELECTRICAL REVIEW at $5.

This book gives several complete systems of factory accounting forms, both the costing and the commercial blanks being accurately reproduced in arrangement. The function and the exact manner of using each form are carefully detailed, enabling the reader to comprehend easily the scope and employment. Chapter one gives a discussion of factory routine, organization and cost finding. Chapter two takes up advances in factory accounting, and the remaining chapters give a full discussion of the methods pursued at six factories of high standing. The book should be most helpful to the factory manager who is reorganizing his shop methods.

"Free-Hand Lettering." Victor T. Wilson. New York. John Wiley & Sons. Cloth. 105 pages. 6 by 9 inches. 23 full-page plates. Supplied by the ELECTRICAL REVIEW at $1.

This is not merely a copybook giving samples of useful and effective lettering. The author believes that good lettering is not a question of careful copying, but rather one of good design; and in order to do good work beyond the merely imitative, certain fundamental truths must be recognized. A brief history is given of the Roman and Gothic letters. Each letter is analyzed, and it is shown how certain variations strengthen or weaken it. The proper method of spacing is explained, and instruction given in the use of free-hand lettering. A chapter on design of lines and of totals shows how the best can be obtained. Special classes of lettering, such as for photographic reproduction, are described, and some mechanical aids to lettering are given. A set of twenty-three full-page plates gives samples of various styles of lettering suitable for a variety of purposes. The book will be not only valuable, but interesting to all who are called upon to do any lettering.

"Modern Wiring Diagrams and Descriptions for Electrical Workers." Henry C. Horstmann and Victor H. Tousley. Chicago. Frederick J. Drake & Company. Flexible leather. 160 pages. 4½ by 6½ inches. 200 illustrations. Supplied by the ELECTRICAL REVIEW at $1.50.

This useful little book is an attempt to supply wiring diagrams to electricians and students, with just such information as will assist them in carrying out any line of work. It contains diagrams of call and alarm circuits of all descriptions, telephone and telegraph circuits, gas lighting, methods of distributing and wiring for electric lights, both arc and incandescent, proper ways of connecting motors and transformers, wiring for motors and motor starters, generators and compensators, switchboard diagrams for both arc and incandescent lights. In addition, it gives some useful hints for locating trouble, for the care of primary and secondary batteries, a brief discussion of the Wheatstone bridge, proper methods of making connections in wires and cables, and wiring tables. The book should be a very handy one for the practical man.

"Beginners' Manual of Submarine Cable Testing and Working." Second edition. G. M. Baines. New York. D. Van Nostrand Company. Cloth. 5¼ by 8¼ inches. 220 pages. Numerous Diagrams. Supplied by the ELECTRICAL REVIEW at $3.50.

In this manual the author attempts to teach the art of submarine cable testing. He starts with the assumption that the reader knows little or nothing about electricity, and no mathematics beyond arithmetic or very elementary algebra. The several types of battery are explained, and the fundamental laws of electrical conductors are given and illustrated with numerical examples. Wheatstone's bridge and other methods of making measurements of the electrical quantities are given, and the effect of physical conditions, such as temperatures, studied. This portion of the book comprises ninety-eight pages. The remainder of part one —seventy pages—is given up to the various methods of cable testing. These are all explained in the simplest manner possible and illustrated with numerical examples. Part two takes up a number of devices employed in submarine telegraphy, such as transmitters, lightning arresters, recorders, methods of duplexing, and the use of condensers. The last chapter gives a brief explanation of the dynamo, the telephone, and a word or two about storage batteries.

"Practical Lessons in Electricity." American School of Correspondence at the Armour Institute of Technology, author and publisher. Chicago. Cloth. 90 pages. 7 by 10 inches. Numerous illustrations. Supplied by the ELECTRICAL REVIEW at 90 cents.

This book has been selected from the electrical engineering course of the American School of Correspondence at the Armour Institute of Technology, and has been compiled for the purpose of showing the standard of instruction and the scientific manner in which these books are prepared. The price, it is stated, barely covers the cost of binding. The chapter on storage batteries has been prepared by Professor F. B. Crocker, head of the electrical engineering department of Columbia University; and that on electrical wiring has been prepared by Mr. H. C. Cushing, Jr., the author of "Standard Wiring;" those on the elements of electricity and the electric current having been prepared by L. K. Sager. The various phenomena connected with the production and use of electricity are taken up in easy steps and in an elementary fashion, from a brief study of magnetism and its effects. In each chapter the aim is made to give the student a rather broad view of the possibilities of further study in the same direction. In the volume under discussion, there are no mathematical formulæ which should give trouble to any one who has the most ordinary idea of arithmetic. The different chapters are supplemented by a list of questions, which is a help in pointing out the line of thought to be followed in taking up the work.

Electrification of the Great Western Railway, England.

The London *Electrician* reports that the Great Western Railway Company, of England, is contemplating the conversion of certain of its lines from steam to electricity. To effect this, a contract for engines, three-phase generators, condensing and auxiliary plant, aggregating 10,000 horse-power, has been let to the Electric Construction Company, of Wolverhampton, England. The station will be at Park Royal, and the first section of line to be electrified will be that from Bishop's road to Hammersmith.

Canadian Electric Railways.

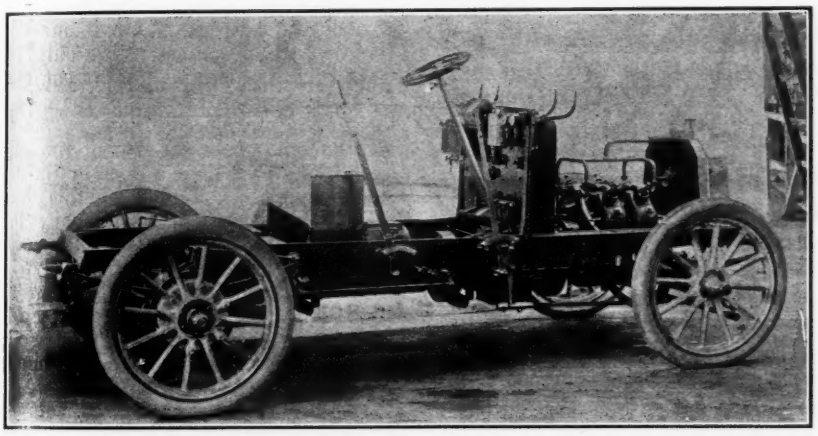
In a recent report from United States Consul A. G. Seyfert, at Stratford, Ontario, the following data on Canadian electric railway appear: there were forty-four companies sending in returns; 421.39 miles of single track; 188.09 miles of double track; 1,895 motor cars; 326 trailer cars; 97 snow sweepers and plows; 36,711,130 miles run; 145,609,993 passengers carried; 5,427 employés; $25,961,254 capital paid up; $15,794,408 bonded debt; $6,865,907 gross earnings; gross expenses $4,140,490.

The French Automobile Show.

(By Our Special Correspondent.)

THE sixth annual Automobile Show which was recently held at Paris, was even a greater success than the preceding one, and considerable progress along all the lines of automobile construction could be observed. The show was held in the large palace of the Champs-Elysées.

The combination of an electric and a petrol system in the same automobile is a subject which is receiving increased attention from different constructors in Europe, especially in France, and several forms of combination cars were to be seen at the show. These may be divided into two general classes. In the first, the electric system is used simply to obtain the speed transmission from the petrol motor to the rear axle. The motor is placed in the front of the car and runs a dynamo which is direct-coupled to it. The dynamo is in turn used to operate an electric motor which is geared to the rear axle.



CHASSIS OF COMBINATION PETROL-ELECTRIC MOTOR CAR.

The second class of combination car, which was represented by several of the leading firms, is that in which a petrol motor drives a dynamo which is direct-coupled to it. The dynamo is here used to charge a set of accumulators which are carried on the car. The petrol motor can be made to operate alone, or if need be the accumulators can be brought into action and operate the electric motor, thus propelling the car without any other aid. The gasoline and electric motor can also be used together, and their added power enables the car to pass up high grades and over obstacles with ease. Of the latter type, one of the most successful systems is that which has been recently brought out by the Compagnie de l'Industrie Electrique et Mecanique, the well-known electrical constructors of Geneva.

The dynamo which is carried on the car is calculated to produce a voltage which is equal to that of the battery for a certain speed of the motor. The speed which gives this voltage is somewhat lower than the normal speed of the petrol motor when in ordinary running on a level or on slight grades. If we suppose that the normal speed corresponds to a grade of three to five per cent and the motor now furnishes 1,000 revolutions per minute, when the car descends the grade the motor speed will rise to 1,200 revolutions, and under these conditions the voltage of the dynamo will become higher than that of the battery. The dynamo will act as a generator and charge the storage battery, storing up energy in the latter. On the other hand, when the car is climbing up a ten per cent grade, the speed of the petrol motor will fall, say, to 800 revolutions per minute, and the voltage of the dynamo will descend below that of the battery. The accumulators will now run the dynamo as a motor and will come in automatically without needing any manœuvre to aid the petrol motor to overcome the resistance which it is working against.

The engraving shows the chassis of the new combination car. In front is the petrol motor, which has been designed specially for this type of automobile by the Compagnie de l'Industrie Electrique. The present motor has four cylinders and consists of two motors built together. The simple motor has two cylinders placed in V-form upon a cylindrical crank-box. This construction has been adopted in order to take up less room in the horizontal direction, and thus leave more space for the electric equipment.

The second form of car is provided with a heavier battery so as to enable the car to cover longer distances by the aid of the battery alone. It is built in two-cylinder, eight-horse-power, and four-cylinder, sixteen-horse-power. These cars contain a battery of forty-four cells which weighs 1,100 pounds. They are designed to operate either with gasoline or electric power, and the reserve of energy in the battery will take the car over a distance of twenty-five to thirty miles without the aid of the petrol motor.

When the car has finished its run it can be made use of to provide a source of current, and this will prove especially useful for lighting a city or suburban residence. The battery of 330 pounds which is carried on the usual type of car is sufficient to supply fifty lamps of ten-candle-power for one hour or ten lamps for six hours. When it is desired to burn a greater number of lamps the petrol motor can be set working and the dynamo charges up the battery.

The electro-catalytic spark-plug is a new device which operates upon the principle of incandescence produced by occluded hydrogen in certain metals of the platinum group. As is well known, platinum, palladium and other metals when in a finely divided state when exposed to hydrogen or hydrocarbon gases have their temperature raised on account of the occlusion of the gas by the metal, and under some conditions will become incandescent. After a series of experiments M. A. Wydts, the inventor of the plug and a skilled physicist, succeeded in adapting this principle for bringing about the ignition of the explosive mixture in petrol motors. He found an alloy of different metals, notably osmium and ruthenium, which when in the form of a fine filament become incandescent to a high degree when exposed to the action of hydrocarbon gases, and he succeeded in making a filament which should be sufficiently solid and stand the high temperature. The filament which is thus prepared is placed in a spark-plug especially designed for the purpose and inserted in the explosion chamber of the motor. The gas arrives at the filament through a narrow opening.

A small current is sent through the filament in order to increase its action.

While the plug can be made to work by the action of the gas alone, it is found desirable in practice to send through it the current from a small battery in order to give it a somewhat high initial temperature. The characteristic property of the device is that when the gas is compressed in the motor cylinder its action on the filament causes the latter to become incandescent and reach a high temperature simply on account of the action of the occluded gases. The white-hot filament thus serves to ignite the gas in the explosion chamber, and thus takes the place of the usual induction spark. The current not only serves to heat up the filament, but experiment shows that it has the effect of increasing the catalytic action which is exerted by the metal. The reason for this effect has not as yet been well explained. The new method of ignition has the advantage of suppressing the use of porcelain in the plug, which gives considerable trouble on account of breakage. A still greater advantage lies in the fact that the induction coil with its vibrating contacts is now dispensed with.

A form of spark-plug which gives two sparks simultaneously is one of the novelties which was remarked in this line. The advantages which are claimed for this method are that the gas is more certain to explode, owing to the action of the two sparks, and therefore misfires are less likely to occur. The ignition takes place under more favorable conditions, and this gives a greater explosive force to the gas, increasing the power of the motor. One of the new plugs is the "Bougie Disruptrice."

Another spark-plug which carries out the same principle by a different construction is the "Darop," which is manufactured at Amiens.

The method of double spark is also employed in the Louet automobile for its new three and six-cylinder motors. In this case, however, the two sparks are produced simultaneously within the explosion chamber of the cylinder, but at a considerable distance apart. Two spark-plugs of the usual type are inserted in the cylinder head and these are placed as far apart as practicable. The two plugs are connected in series through the mass of the motor. On making the contact for the induction coil, a spark occurs simultaneously in the two plugs. The gas is ignited at two different points and consequently the explosion takes place more quickly and very effectively. The inventors state that they obtain an increase of ten or fifteen per cent in the efficiency of the motor by this means.

Another spark-plug affords an ingenious device for observing the spark while it occurs within the motor, and thus control the action of the plug and see whether it is working properly. The plug is screwed into a T-shaped socket which fits into the motor. At the other end of the socket is a nut which closes it; the latter is provided with a conical hole which is closed at the inner end by a thick lens. On looking into the orifice, the spark can be seen, and also the flame which is produced by the explosion. In this way one can observe the action; and see whether the ignition is working well and if the carburation of the gas is well regulated. To note the latter point the color of the explosion flame is taken into account. A light blue flame shows that the explosive mixture has not enough gas, while a yellow flame indicates that the mixture has two large a proportion of gasoline. A blue-violet flame shows that the mixture is good and is working properly. This very simple device seems, therefore, to be of considerable utility in the operation of automobile or fixed motors.

C. L. DURAND.

Paris, January 16.

The Action of Radium, Roentgen Rays and Ultra-Violet Light on Minerals and Gems.

At a recent meeting of the New York Academy of Sciences, Messrs. George F. Kunz and Charles Baskerville described an elaborate series of tests with Roentgen rays, radium and ultra-violet light, conducted on the gems and gem material of the Tiffany-Morgan collection and the Morgan-Bement collection. Some of the gems were apparently unaffected by these invisible rays, while others became phosphorescent and others fluorescent, glowing with tints of various colors. These experiments lead the authors to believe that certain of the gems contain elements as yet unidentified. Thus, willemite and the artificial phosphorescent zinc sulphide and zinc oxide seem to contain an element having an affinity for zinc. In fluorspar there seems to exist either yttrium or ytterbium. Calcite from Franklin, N. J., contains probably yet another body, and autumite contains a fluorescent substance which differs from anything that they have noticed in any other minerals. The most responsive of all the gems are diamonds containing that peculiar substance that gives them what is known as the blue-white color. This study leads the authors to believe that one or the other of these forms of luminosity and activity may have a value to detect elements or compounds that have escaped notice, or are present in minerals as impurities; and these forms of investigation may also prove serviceable in chemical analysis. A tentative classification is submitted of mineral substances. In this, minerals are to be classified according as they respond to any one, or any combination, or to none of the three forms of radiation used.

Labor and Invention.[1]

The world now to be governed is getting more and more complex. Man is utilizing the energies of nature in thousands of ways unknown to the ancients. Common people are all getting educated. Where the ancients wondered and trembled, we understand and give orders to nature. The average unit of any population was compelled to be what we now call an unskilled laborer.

Now our labor is becoming more and more skilled. Are you aware that from one ton of coal there is as much energy, as much actual work, as may be done by 40,000 good laborers in a ten-hour day? Our best steam engines utilize only one-tenth of this energy at the present time. But even now we know that the cost of the most unskilled work done by man is one thousand times the cost of the same work wherever it may be done by the best steam engine. One fact of this kind, properly considered, is worth many long essays about the effect of the engineer in altering all the character of our civilization. It is labor that is the true standard of wealth. The steam engine has added incalculably to the wealth of the world. We forget that man is no longer needed for unskilled labor, so that when we use unskilled labor we are using the materials which God has given us in the most inefficient manner possible. Furthermore, it becomes sweated labor, it unduly taxes skilled labor, it starves invention, and it brings up base and ill-fed families.

Electrical Apparatus in Korea.

Railways, telegraphs, telephones and a postal system have been recently introduced into Korea. A railway from the seaport of Chemulpo to Seoul, the capital, a distance of twenty-six miles, was built by American contractors, and has reduced the time between the seaport and capital from eight hours to one and three-quarters hours. The Seoul Electric Company, organized chiefly by Americans and with American capital, has built and operated an electrical railway near Seoul, which is much used by the natives. This electrical plant is said to be the largest single electrical plant in Asia. The machinery is imported from the United States, and the consulting engineer, a Japanese, is a graduate of the Massachusetts Institute of Technology.

[1] Excerpt from an address delivered by Dr. John Perry at a public meeting at Oxford, England.

Northwestern Electrical Association.

Twelfth Annual Convention Held at Milwaukee, Wis., January 20, 21 and 22, 1904.

THE twelfth annual convention of the Northwestern Electrical Association was held at the Hotel Pfister, Milwaukee, Wis., Wednesday, Thursday and Friday, January 20, 21 and 22, 1904. The convention was called to order at the club room, January 20, 1904, at twelve noon, by the president, Mr. F. W. Bowen, who announced the programme for the three days.

The secretary-treasurer's report was presented by Mr. Thomas R. Mercein, of which the following is an abstract:

I call your attention to the resolution adopted last January to hold a summer meeting at St. Louis this year in connection with the National Electric Light Association. I learn that the National association will hold its regular meeting at Boston in June next and another meeting in September in St. Louis. Whether or not this will make any change in our plans is for this convention to decide. I was able to secure over $200 worth of advertising for our last report, the largest amount we have ever received from that source, and making the cost of the publication but a small item of expense to the association, and I have, as heretofore, contracted with the leading electrical journals for special reports of this convention and reducing its expense $80 thereby. The plan of printing convention papers in advance is continued as it evidently meets with favor and is, in my judgment, worth the extra cost.

Adjournment was made until 1.45 P. M., when the president delivered the annual address, saying in part:

It is with the utmost pleasure that I welcome and greet you at this the twelfth annual convention of this association, which will, I hope, if such a thing be possible, be of even greater interest to our membership than any which has preceded it. I would, however, expressly disclaim responsibility for such a happy result, but on the contrary place the credit for it where it is due, with our worthy and esteemed secretary.

The commercial side of every proposition is the one which most appeals to the central station man, and it is to be expected therefore that those side lights will be thrown on the papers to be read, and it is right and proper that it should be so. It is, of course, from the technical side that the papers are written, and it is from the operative side that they are in measure discussed.

During the year which has but just passed over into history there has been much done which is of interest to our profession, though no startling discoveries or innovations have been brought forward, if possibly we may except the mercury vapor lamp; but still the year has witnessed better development of many appliances, and it is now more than probable that each future year will add to this general betterment, though with less of novel ideas to attract and possibly, as in the past, to discard. The general principles of our business seem to be better settled and more fully grounded and the lines of machine building seem to have reached their ultimate for a considerable time at least, and therefore the central station man is very much nearer a standard than ever before. This is a hopeful sign for our chosen business and it is probable that our depreciation accounts will be the gainer from the fact that the various apparatus used will not be found, as in the past, to be obsolete almost as soon as installed.

The twin subjects of taxation and municipal ownership are and always will be with us. I am, however, very much of the opinion that both are more likely to be met more in the spirit of fairness than in the past. I have no recommendations in the nature of a cure at all to make upon these important subjects, and can only say that as the nature and hazards of our business are more understood by the general public we will be better treated by the same public through their chosen representatives. Let us at all times treat them with fairness and strive by our good treatment of the public, from whom we receive our franchise, to merit their good will, give them the best possible service for the least possible cost to them and we will make friends instead of enemies, or at best doubtful friends, as many seem to think us. The standardization, of which I have spoken, will ultimately be the means of enabling central stations to manufacture their output commodity at a cost which will enable them to supply the public on terms that will, while selling their output at a non-restrictive price, yet realize a fair and equitable profit on their sales, which from the very fact that they are selling standard goods, will increase by the application of their product to many new uses by the consumer.

This then will still further operate to make friends of the general public and thus in a measure silence the popular clamor for high and still higher taxes upon our industry and for the establishment of municipal lighting and power plants.

The president made the following appointments:

Nominating Committee: Mr. R. N. Kimball, Kenosha; Mr. H. W. Frund, Vincennes, and Mr. P. H. Korst, Janesville. Membership Committee: Mr. J. H. Harding, La Porte; Mr. W. H. Schott, Chicago, and Mr. Irving P. Lord, Waupaca. Applications for membership were then presented and referred to membership committee.

The report of the "committee on uniformity of advertising matter," of which Mr. H. J. Gille, of St. Paul, is chairman, was presented. This was a progress report and Mr. Gille urged the addition to the committee of the following gentlemen: Mr. H. Almert, of the Cicero Light, Heat and Power Company, Oak Park, Ill.; Frank G. Bolles, New York city, and Professor Philip B. Woodworth, Lewis Institute, Chicago, Ill. A number of letters were read from prominent manufacturers and central station men, and after the election of members it was moved that Mr. Almert be made a member of the "committee on uniformity of advertising matter," and that Messrs. Bolles and Woodworth be invited to cooperate with this committee. This was carried.

A paper by Mr. W. H. Schott, on "Central Station Heating," was read:

Heat may be delivered from a central point to almost any reasonable distance, by means either of water or steam; but the question to be decided upon when a central station plant is to be constructed is, which shall be used? Heating plants are a better investment where exhaust steam is utilized in furnishing at least a part of the heat. It can be used more economically in a hot-water system than in a steam system, due to the fact that it may be used at atmospheric pressure, or even below this, circulation being made positive by means of a pump.

Taking up the question of the central station heating plant, the territory to be supplied should be carefully examined. If the undertaking promises to be profitable, a franchise should be obtained, and the work carried out in the best possible manner. Care and judgment are needed in piping buildings, and all pipes, whether for steam or water, should be covered.

Neglect of this latter precaution is the cause of the unsatisfactory operation of many heating plants. Some form of regulation is an absolute necessity, and this is easier to accomplish without automatic regulation with a water system than with steam. A regulating system, the author believes, would effect a saving of about forty per cent over one not properly regulated. The question of the probable capacity of the heating plant was discussed, and the conditions affecting this.

Heating is charged for in three ways—by the cubical contents of the space heated, by the number of square feet of radiating surface, and by the amount of condensed steam in the steam system. With radiation furnished on a square foot basis, and without regulation, the cost would be prohibitive; but the application of regulation acts practically in the same capacity as the meter acts to the electric light plant—furnishing the necessary amount of heat, customers are better satisfied, and the income is higher than when based on a meter reading. Probably the ideal method of furnishing heat would be to use both a meter and automatic regulation.

A chart was exhibited showing the average performance of a plant for a week. A very constant temperature was maintained within the building, and no manipulation of valves was required, as the circulation was controlled automatically and was cut off over forty per cent of the time. If a light and power plant were in a position to furnish heat also, it could eliminate a large percentage of the isolated plants. At present the average large building must maintain a boiler plant seven or eight months during each year for heating.

The president called upon Mr. Harding to open the discussion, who was followed by Mr. Almert.

Mr. Almert: In a system with a fairly tight boiler and heating plant, heating, say, 200 or 210 days a year, and using coal 11,500 to 12,000 British thermal units, costing, say, $2.25 a ton, what would be the cost for coal per year?

Mr. Schott: Taking the coal cost on the water proposition, in a test made recently by Purdue University, Professor Goss there reports that he finds the cost was fifty per cent higher than it should be due to the condition of the plant; that the cost was 3.8 cents per square foot per season, based upon each $1 of cost for fuel. In that particular case the coal tested 10,500 British thermal units; that would put it on a $2 price for coal. Assume that same value of coal, it would cost a fraction under eight cents per square foot per season. That is for water. Now, the actual test was seventy-seven pounds of coal per square foot of radiation per season. Our figures were about seventy pounds of coal.

With a steam proposition which runs 130 pounds per square foot, an estimate can easily be arrived at to determine the cost, with regulation; without regulation it will run as high as 180 pounds per square foot.

Mr. Kimball: In Kenosha we have great difficulty in differentiating between what is properly chargeable to the electric lighting plant and what is properly chargeable to the heating plant, where we are running a combined plant, and we are inclined to separate them as much as we can, and not give the electric plant credit due to the heating plant. We found we ran about seventy-seven pounds of coal per square foot of radiation in addition to the exhaust steam we put into the heating—that is upon the 12,500 British thermal unit basis.

Mr. Schott: On the Purdue test everything was charged against the heating plant except the efficiency of the engines and pumps. The engines in that case absorbed seven per cent of the heat transmitted to them, and the pump absorbed four per cent. When it came to the condensation, the engines tested at twenty-eight and one-half pounds and the pumps ran ninety-five and one-half pounds per indicated horse-power per hour, and everything was charged against the heating plant except the actual heat units absorbed by the engines and pumps.

Mr. Harding: I would like to ask what difference there would be between furnishing heat on that basis with a regulator running direct from your plant, and without a regulator, and the cost of furnishing it with regulators, speaking of a hot water plant?

Mr. Schott: The test has proven that the difference in operation is just about forty per cent. If it is going to cost you forty per cent more to operate, you ought to get forty per cent more income. It won't affect the labor end of it so much as the actual fuel burning; but on account of acquiring a larger percentage to take care of an equal amount of space, it will take more plant; so that if you consider as a whole the increase at forty per cent you ought to get at least forty per cent more for heating without regulation than with it, to be on the same plane.

Mr. Kimball: Does not your forty per cent represent water pumped and not difference in fuel, in that test?

Mr. Schott: In that test everything was taken into consideration—labor, fuel and everything. The amount of heat thrown off governs the amount of coal burned, and the number of degrees drop in water depends on how you are working your plant. Some plants will work ten or twelve degrees, some fifteen or twenty, and we have them as high as thirty. The heavier the load on the plant, the greater the drop will be in the water, on an average. The lighter the load the less you will have in temperature, and in this test, as I say, everything was taken into consideration.

The next paper was entitled "Coil Winding for Electrical Purposes," by Richard Varley and Charles R. Underhill. This was read by Mr. Underhill, who was given a vote of thanks.

The general requirements in the design of a good electromagnet were considered. The data which should be furnished in ordering a magnet are the pull, either uniform or accelerating, the distance through which the pull must act, the time the current is to be on the magnet, and the length of time between the contacts operating the magnet. It should also be specified whether the magnet is to be in a vertical or lateral position. The general performance of electromagnets was discussed, attention being called to the fact that the relation between air-gap and pull does not vary by any known law. The importance of proper winding was emphasized, and a method of determining this given.

A paper entitled "The Electrolytic Rectifier and Interrupter" was read by the secretary, the author, Dr. W. Scheidel, not being present. This paper described the construction and operation of the "Churcher" alternating-current rectifier.

There was no discussion on this paper and the president called for the paper by Mr. George C. Keech, on the "Smashing Point of Incandescent Lamps."

In this paper, Mr. Keech described the ideal lamp as one which would operate perfectly up to a certain point, and then die naturally. He cited many instances of trouble with consumers due to defective lamps, and of the necessity of renewals. He thought that when a lamp had depreciated twenty per cent in candle-power it should be removed and smashed. This paper was the subject of considerable discussion, a part of which follows:

President: As I stated in my opening address, the commercial side of all these propositions is the one which appeals most strongly to the central station man. A fifty-six-watt lamp will burn in 17.86 hours one kilowatt on a three and one-half kilowatt basis. Now if the average price of a lamp were eighteen cents and its average useful life up to eighty per cent of its candle-power were 600 hours, then it would represent a cost of the lamp of 0.003 of a cent per hour to burn. Now then, if we find that we have that lamp consuming for us and giving us a revenue from 17.86 kilowatts during its life down to its eighty per cent, assuming it to be $600, then the cost of renewal, it appears to me, would be about 0.0053 of a cent per kilowatt of current sold. That is worth thinking about. If any of you have been in the habit or have not been in the habit of making lamp renewals, I would like to have my figures proven, because I made them very carefully.

Mr. Schott: I find, according to my report, that the average renewals are about a lamp per year for your connected load. For instance, with about 7,000 lamps connected with your station, about 7,000 would be the average number of your renewals. That will vary somewhat when you take into consideration the character of the business to which you are furnishing current, and that statement applies particularly to a residence territory, but if you have a commercial plant the percentage of renewals will materially increase. In the Indianapolis plant we have strictly a commercial business; we have a load line running sixteen hours a day, and the renewals run up; but in the ordinary country plant, where anywhere from thirty to sixty per cent of the connected load is for residence use, about one lamp per year for each lamp connected would be a fair average to consider. In a town of 10,000 or 12,000 inhabitants, 7,000 lamp renewals would cost about $1,400; and you can readily arrive at a percentage basis from these figures.

President: No stated percentage of the cost of renewals can be given. To my mind the question is what does it cost you per kilowatt-hour of current sold per lamp renewals, and that is the whole story.

Mr. Harding: For a number of years I have obtained a good deal better results by following out this plan: during the heavy part of the evening—the important lighting hours of the evening—I am in the habit of running my lamps two volts high, the 108-volt lamps at 110, cutting off along about half-past ten back to the 108-volt, and maintaining it there for the balance of the twenty-four hours, or until the lighting load comes on the next afternoon. In doing that I have materially reduced the lamp renewals on our plant, and I know that I am giving better satisfaction to my customers than I did when I undertook to hold my voltage right at the voltage that the lamp was built to run at. It is a well-known fact that you take a lamp and put it out on the circuit and go to any plant operating it at the required voltage and they complain that the lamps are dead, and we find in order to hold up business that it is necessary to force the lamps up during those hours. The balance of the time it is all right.

Following the discussion, adjournment was made until 10 A. M., January 21.

THURSDAY SESSION.

The first paper taken up was entitled "Double-Current Generators," by Mr. W. L. Waters.

Mr. Waters did not read his paper in full, but said:

I propose to deal with this question of double-current generators more from the standpoint of the manufacturer than from that of the central station engineer, partly from the fact that that is a standpoint likely to be less familiar to you than any other, and partly because it will enable you to answer the question which is so often asked, why double-current generators are so seldom used, despite their obvious advantages? It is the old question of alternating currents *vs.* direct. The advantage of alternating currents, of course, is the ease with which they can be generated and handled at high voltage, and the ease with which they can be transformed by means of stationary transformers. The direct current, on the other hand, is not suitable for use at high voltages, but is suitable for all classes of motor work, and while it is very difficult to use alternating currents, or they are very unsuitable for street railway work, or in variable speed motors, or elevator motors, that is just the case in which the direct current is most suitable; so that you can see that alternating and direct currents are to a certain extent complementary; the advantages of the one correspond to the disadvantages of the other and *vice versa.*

From the manufacturer's point of view, the great disadvantage of double-current generators (and that is the main reason why so few are being installed) is that double-current generators are usually special machines; they usually mean special designs, patterns and dies for the manufacturer, and he might have to use those designs and patterns just on that one machine; if that is so, of course the central station man has to pay for that. Of course you can take any direct-current generator and put collector rings on the back end and make an alternating-current machine out of it. The reason that it can not be used as a double-current generator is because the frequency is usually unsuitable. The frequencies in use for alternating-current generators are pretty well standardized at twenty-five, forty and sixty. The ordinary engine-type, slow-speed generator will not often fit in with that frequency. You can take an alternator and design it for almost any frequency, voltage or speed you like without extra cost; but if you come to a direct-current machine the question is different; the voltage and output of the machine practically decide the number of poles that are going on that machine, and that with the speed decides the frequency. If that number of poles has to be altered in order to get another frequency, to make it suitable for our direct-current generator, that may increase the cost of the machine very considerably, and I have known cases where it has doubled the cost of the machine, and for that reason manufacturers try to argue customers out of the idea of a double-current generator. For if they supply you with a motor-generator for a rotary converter, or two machines, an alternating-current and a direct-current generator, they are all standard machines, and it is to their advantage to get you to buy these machines, and they will do it if they can persuade you, and if you get them to take an order for a direct-current generator usually it is at a very high price, because it means a special machine.

Speaking generally of double-current generators, as regards the difficulty of manufacture and operation, they are much the same as rotary converters. Twenty-five and forty-cycle machines can be built quite easily, but when you get a sixty-cycle machine you begin to get difficulties on the commutator on account of the high peripheral speed, which on a 500-volt machine is quite serious. To get sixty cycles you must have a certain number of poles, and to have a reasonable number of volts for a commutator bar, you can not go too high; that gives you a certain number of segments on the commutator, and that with the speed gives you the design of the commutator, and that gives extremely high pheripheral speed on the commutator, a large number of segments, and the commutators are very difficult to build. Though they have run satisfactorily, it is an even chance whether you will get through without trouble; you will probably have the bars rising or something like that.

The brush gear is important when you run these high speeds. As far as I know there is no brush gear on the market that is perfectly satisfactory on a sixty-cycle 500-volt machine. A number of them are running with rotary converters which get along satisfactorily, but from the point of view of the testing room man and operating engineer, they can hardly be called satisfactory.

Following the discussion on the paper, Professor Charles F. Burgess read a paper on "Rectifiers." Professor Burgess cited the three different forms of rectifiers, mechanical, vapor and electrolytic, and called attention to the recent work of Mr. Peter Cooper Hewitt. He took up in detail the elements which a rectifier must possess for successful operation and commented on the weakness and limitations of the various type of apparatus which have been developed. This paper excited a great deal of discussion and brought up the possibility of adding a light-weight rectifier to the equipment of an electric automobile, and charging the batteries from any alternating-current source of power. He said: "for short charging service you can make a transformer a good deal lighter than it is ordinarily made, because you do not care if you do heat it up some. So it seems to me it is entirely feasible to construct a device which can be carried around with your automobile. I do not know if it has been done as yet, but it seems to me entirely practicable."

President: It looks to me as though any proposition of this kind necessarily must be viewed from the commercial side, and I want to ask the professor a question just as a matter of information. I heard him mention a moment ago an efficiency of about fifty per cent. Now, from that should I be led to understand that you could get the necessary direct current out

of double the price you paid for your alternating current per kilowatt?

Yes, sir.

The nominating committee made its report, which was unanimously adopted and the secretary cast a single ballot for the following officers and directors:

T. F. Grover, Fond du Lac, president.

George H. Lukes, Evanston, first vice-president.

E. A. Daniell, Menominee, second vice-president.

Thomas R. Mercein, Milwaukee, secretary-treasurer.

W. H. Schott, Chicago, director.

D. C. Jackson, Madison, director.

H. Almert, Oak Park, director.

Mr. Grover thanked the association and the committee for the trust they had invested him with, and pledged his earnest work as executive.

Mr. Mercein, the secretary, then addressed the meeting: I wish to speak of a reference in my report to the action taken last January as to the summer meeting. At the instance of Mr. Doherty, our former president, who advised the taking of some action as to meeting with the National Light Association at St. Louis, and after some discussion, this convention decided to hold a summer meeting in conjunction with the National association at St. Louis, preferably in June, but I have been informed that the National association will hold its regular meeting in May or June at Boston, and that it will hold another meeting at St. Louis in September; and I suggested as to whether or not that would make any difference in the arrangements of this association in the matter of holding a convention this summer at St. Louis, and I think this ought to be acted upon at this convention

President: After discussion a motion that the summer meeting of the association be held in September at St. Louis, to meet with other electrical associations and electrical people, the date to be left to the executive committee, was carried, and adjournment was voted until 1.45 P. M.

The afternoon session opened with the reading of a paper entitled "Standard Practice in the Use of Alternating-Current Electrical Apparatus," by Mr. J. J. Gibson. In the absence of the author, the paper was read by Mr. J. R. Kimball. This paper was listened to with great interest. It was unfortunate that the author was not present, as no doubt a number of valuable points would have been discussed.

It was moved and seconded that the association send its secretary, Mr. Mercein, as its representative to the annual meeting of the National Electric Light Association, to be held in Boston in the month of May, this motion being carried unanimously.

Mr. J. M. S. Waring then read a paper on "Storage Batteries for Small Central Stations." This paper was illustrated with a number of lantern slides, and was greatly enjoyed.

Mr. James Lyman read a paper on "The Curtis Steam Turbine," and exhibited a number of interesting views comparing reciprocating engines and steam turbines.

A vote of thanks was tendered to Mr. Lyman for his interesting paper, as was also tendered to Mr. W. J. Ferris for his kindness in allowing the society to have the use of his stereopticon.

Professor R. A. Milliken, of the University of Wisconsin, delivered an illustrated lecture on "Radium."

Professor Milliken took up first the phenomena of X-rays, and cited several instances where certain minerals, particularly uranium, had the property of glowing with a yellowish-green light when exposed to the actinic rays of the sun. He then touched briefly upon the work of Henri Becquerel and Mme. Curie, and the experiments and discoveries connected with the researches concerning pitchblende. He explained the properties of radium and radioactive substances, and took up in detail the experiments which have been performed to identify the nature of the different forms of rays. Professor Milliken also spoke of the use of radium in medicine, and, in conclusion, suggested that, while it did not look now as though it would be of any economic value, even if no practical use were found for it, the greatest end possible has been served, for radioactivity has extended man's knowledge of the way in which nature works, and of the constitution of natural things.

The session adjourned, to meet January 22 at 9 A. M.

On Friday, January 22, the convention was called to order at ten o'clock. There being no business to be transacted, the convention was declared adjourned.

CONVENTION EXHIBITS AND EXHIBITORS.

The conventions of the Northwestern Electrical Association have always attracted a number of exhibitors and representatives from prominent companies. The parlor floor of the Hotel Pfister was occupied by the exhibits, and these proved of great interest to all of the delegates present. Among the companies present were the following:

The General Electric Company was represented by Mr. F. N. Boyer, manager supply department, Chicago; Mr. J. Scribner, manager lighting department, Chicago; Mr. Thomas Ferriss, Wisconsin representative; Mr. W. J. Ferriss and Mr. S. F. Dibblee, small motor department, Chicago.

The Milwaukee Electric Company was represented by Mr. Walter Cary, Mr. I. B. Cary and Mr. T. G. Whaline.

The Fort Wayne Electric Company was represented by Mr. W. S. Goll, Chicago manager; Mr. J. H. Raymond and Mr. C. E. Sedgwick.

The Standard Underground Cable Company was represented by Mr. E. J. Pietzcker.

The Stanley Instrument Company was represented by Mr. F. J. Alderson.

The Crouse-Hinds Electric Company was represented by Mr. F. F. Skeel.

The Phelps Company was represented by Mr. W. E. Phelps.

The Kuhlmann Electric Company was represented by Mr. E. Kuhlmann.

The Julius Andrae & Sons Company was represented by Mr. T. J. Andrae, Mr. J. C. Schmidtbauer and Mr. A. E. Stadelbauer.

The Westinghouse Electric Company was represented by Mr. N. B. Stewart, Mr. A. S. Millard, Mr. W. D. MacDonald and Mr. C. A. Ross.

The National Electric Company was represented by Mr. C. P. Tolman, manager electrical department; Mr. C. G. Burton, manager electrical sales, Chicago; Mr. J. Waters, Mr. A. P. Peck, Mr. N. Knight and Mr. H. M. Klingenfeld.

The Standard Electric and Telephone Company was represented by Mr. James H. Parish.

The Bryan-Marsh Company was represented by Mr. G. F. Keech, Mr. T. P. Sawyer and Mr. J. S. Corby.

The American Electric Works was represented by Mr. J. E. Donahoe.

The Central Electric Company and the Okonite Company were represented by Mr. John Wesley Mason, Mr. W. W. Geisse and Mr. W. H. Schott.

The Chicago Insulated Wire Company was represented by Mr. B. H. Ryder.

The Nernst Lamp Company was represented by Mr. G. E. Bennett.

The Minerallac Company was represented by Mr. A. D. Gillespie.

The American District Steam Company was represented by Mr. J. Charles Young.

The Holophane Glass Company was represented by Mr. J. R. Lansingh and Mr. H. M. Lauritzen.

The Wagner Electric Manufacturing

Company was represented by Mr. Hans J. Mayer.

G. E. Bissell was represented by Mr. L. G. Bassett, of the Chicago office.

The Duncan Electric Company was represented by Mr. Thomas Duncan and Mr. W. Cothrell.

The Haller Machine Company was represented by Mr. W. E. Sinclair and Mr. W. Goltz.

The Pardridge Reflector Company was represented by Mr. A. J. Pardridge.

The Browning Electric Company was represented by Mr. Franklin Sweet.

The Alphaduct Manufacturing Company was represented by Mr. W. M. Porter.

The Kester Electric Company was represented by Mr. F. G. Dickerson, secretary, and Mr. J. E. Goodwin.

The Walker Electric Company was represented by Mr. J. R. Kimball.

The Chase-Shawmut Company.

The Standard Electrical Manufacturing Company was represented by Mr. R. W. Loose.

The General Incandescent Arc Light Company was represented by Mr. Francis Raymond and Mr. Louis Friedmann.

The Electrical Workers, Chicago, was represented by Mr. F. E. Donohoe.

The Cutler-Hammer Company was represented by Mr. Beresford.

The American Circular Loom Company was represented by Mr. Thomas Grier, western manager.

The Bullock Electric Company was represented by Mr. E. G. Bissell, assistant sales manager, St. Louis, Mo.; Mr. L. G. Bassett, engineer, Chicago office, and Mr. H. C. Meyer.

New York Section of the American Electrochemical Society.

A meeting of the New York section of the American Electrochemical Society was held at the Chemists' Club, 108 West Fifty-fifth street, New York city, Tuesday evening, January 26. Dr. C. A. Doremus made some introductory remarks, after which the following papers were read and discussed: "The Commercial Electrolysis of Water," Dr. J. W. Richards, "The Thermochemistry of Electrolytic Dissociation," Mr. C. J. Reed; "A Strange Observation," Dr. Ivar J. Moltke-Hansen. Mr. Augusto J. Rossi exhibited and described some ferro-metals obtained electrically and through electric furnace products, including ferrotitanium, ferrotungsten, ferromolybdenum, ferrochrome, ferrosilicon, ferromanganese and copper-titanium, with accompanying slags and other accessory products.

Spanish War Veterans to Hold a Military Athletic Tournament.

The Spanish War Veterans' organization is to hold a military athletic tournament in the armory of the Twenty-second Regiment, N. G. S. N. Y., on March 5, 1904. In order that the tournament may be held under the auspices and with the sanction of the Military Athletic Union, it has been necessary for the commands to organize the Spanish War Veterans' Athletic Association, and the tournament will be held in the name of this organization. The association is similar to and modeled upon the Grand Army of the Republic. Many comrades are at times in needy circumstances and require financial assistance. The widow and children of deceased comrades frequently require help, and funds are needed to defray the burial expenses of comrades who die in poverty. General Eugene Griffin is corps commander of the State of New York Spanish War Veterans, which comprises about thirty-five commands and nearly 5,000 enrolled members. Great interest has been manifested in the project. The use of the armory has been donated, and the service of all concerned in the tournament, other than professionals, such as the starter, handicapper, etc., have been and will be given free. A number of valuable prizes will be awarded, President Roosevelt and Admiral Dewey having donated cups, as have also the Hon. Elihu Root, Secretary of War; General Robert Shaw Oliver, Assistant Secretary of War; George L. Gillispie, chief of engineers; General William Crozier, chief of ordnance; Colonel John Jacob Astor, Senator Depew, Senator Platt, Senator Proctor, Senator Hanna, Senator Lodge, Senator Alger, the Hon. George B. McClellan and the Hon. William Randolph Hearst. It is expected that other prizes will be offered by prominent officials of the army and navy, by senators and representatives of the United States Congress, and by governors of states. Subscriptions from those interested should be paid to General Eugene Griffin, at 44 Broad street, New York city, for the prize fund tournament.

Convention of the National Electric Light Association.

The executive committee of the National Electric Light Association held a meeting at the Waldorf-Astoria, New York city, on January 25. At this meeting it was decided to hold the next convention at Boston, Mass., May 24, 25 and 26, 1904.

The Annual Dinner of the American Institute of Electrical Engineers to Be Held on February 11, 1904.

The annual dinner of the American Institute of Electrical Engineers will be held on Thursday evening, February 11, at seven o'clock, in the ballroom of the Waldorf-Astoria, Thirty-fourth street and Fifth avenue, New York city. The guest of honor will be Mr. Thomas A. Edison. It is expected that an opportunity will be given for members to meet Mr. Edison at an informal reception at six-thirty o'clock.

The Edison Medal Association will present to the Institute on the occasion of the dinner the fund raised to found an Edison medal, celebrating the twenty-fifth anniversary of the perfection and successful introduction of the incandescent lamp.

The following gentlemen have already consented to speak: Mr. B. J. Arnold, president; Mr. T. C. Martin, toastmaster; Mr. Samuel Insull, president of the Edison Medal Association; Mr. Charles L. Edgar, president of the National Electric Light Association; Dr. A. E. Kennelly, Harvard University; Professor Cyrus F. Brackett, Princeton University; J. B. McCall, president of the Association of Edison Illuminating Companies.

The price of tickets (wine extra) will be—gentlemen, $7; ladies, $5. The admission to galleries will be $1.

Belgian Society of Electricians.

The annual meeting of the Société Belge d'Electriciens was held in Brussels, December 19, when M. Emile Closset was elected president for the year 1904. After the business meeting the retiring president, M. Leon Gerard, read a paper on "Turbines from a Central Station Point of View." This was followed by a paper by M. Weissenbruch, chief engineer of the Belgian state railways, on "Electric Signaling on Railways."

The annual dinner of the society was held in the evening, and on the following day an excursion was made to Antwerp, where a number of stations were visited.

Diplomatic and Consular Service of the United States.

The Department of Commerce and Labor, at Washington, has issued a bulletin describing the origin and purpose of the diplomatic and consular service of the United States. This gives a complete roster of all the consular officers, and maps showing the location and classification of these officers in each grand division of the world.

STEAM AND INTERNAL COMBUSTION ENGINES COMPARED FOR CENTRAL STATION WORK.

BY NORMAN McCARTY.

The cost of a kilowatt-hour on the switchboard of an electric lighting or power transmission plant depends principally on the character of the load and experience of the employé, and is largely independent of the conditions regulating the acceptance tests on machinery at the time of installation.

There is a great difference between an acceptance test to establish an evaporation of "eleven pounds of water from and at 212 degrees per pound of combustible," and the average conditions under which this battery of boilers must operate. No doubt the same results could be secured at any time that conditions were favorable, but intermittent demand for power, through the exceedingly varying conditions of service, makes it impossible to secure the maximum economy even with expert help, which a small plant can not afford. Combine this with a tendency to use "low-priced coal" simply because it is low priced, with low-priced help, and this with the necessity of keeping under steam double the number of boilers required for the immediate needs only because they will be needed later, will affect the economy of the boiler plant to such an extent that the evaporation of seven and one-half pounds of water per pound of average coal at the average temperature of feed water, would be considered a very satisfactory economy.

The same difficulties are experienced in the engine room. Simple engines of 100 to 200 horse-power will develop an indicated horse-power at full load, or point of highest economy, on from twenty-five to thirty-five pounds of steam, and, if running compound or condensing, would probably reduce the consumption twenty-five per cent. Smaller sizes will use very much more, and few manufacturers will guarantee these sizes. But with the average central station load, varying from twenty-five per cent to full load, the consumption of fuel would often be found to be double the amount of the manufacturer's guarantee. There can be no economy expected in a central station that is obliged to drag a 300-horse-power Corliss engine through the last half of the night simply to take care of a few street lights or a small all night commercial load, unless combined with a storage battery which will increase the original investment and depreciation account.

No manufacturer of engine or boilers will guarantee his economy except under specified conditions. Neither will he unite on a general guarantee of the combined plant. All guarantees cease when plant is tested and accepted, and the purchaser is obliged to depend on his own conditions for fuel economy. It is absolutely impossible for it to be otherwise in a steam plant, where there are so many conditions that may affect the result, such as cylinder condensation and reevaporation on light loads, low temperature of feed water, wasteful demands of the small auxiliaries, such as pumps, etc., inexperienced or inefficient firing, cheap and unsatisfactory coal, and others, almost without number, that tend to destroy the economy of a plant when all units are combined—although each in themselves may be of the very highest economy when operating under the conditions corresponding to its guarantee.

The most experienced fireman or even an automatic stoker can not follow a variable load, and keep the coal consumption at its proper proportion.

An ideal power plant would consist of internal combustion engines, combining the following requirements for economical generation of power:

1. Simplicity of construction and compactness of design.
2. Reliability of service.
3. Independent units of convenient size with high economy on variable load from friction load to fuel load, and no stand-by losses.
4. A cheap, reliable and plentiful fuel of constant heat value.
5. Automatic control of fuel—proportional to the load—entirely independent of manual control of any kind.
6. Application of heat directly on moving parts and not through a secondary medium.
7. Ignition of fuel in cylinder by means of independent compression of pure air, eliminating igniters of all kinds and preventing back-firing.

Such a plant could be guaranteed by the builder, after being accepted by the purchaser, and it would be no hardship to guarantee the cost per kilowatt-hour on switchboard per year under any condition of load or attendance.

The writer has recently completed a statement showing the itemized cost of operation of eight internal combustion engine plants in small units, using crude oil or residuum for fuel; the results of which are found in this article. These engines were of the Diesel type, the average load varying from twenty-five per cent to ninety per cent of rated capacity of plant.

The cost for fuel being 1.3 mills in the case of the Southern Pacific Railroad shops at Tucson, Ariz., at sixty-six per cent average load with oil at 1.75 cents per gallon, to 3.9 mills in the case of the American & British Manufacturing Company, Providence, R. I., with oil at five cents per gallon, per brake-horse-power at ninety per cent average load.

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Location.	Size of Plant, B. H. P.	No. of Days Run.	Hours per Day for Each Engine.	Total Engine Hours.	Average Load in % of Full Load.	Total K. W. Hours on Switchboard.	Total B. H. P. Hours.	Total Gallons Oil.	Price per Gallon.	Cost of Oil.	Cost of Fuel per K. W.	Cost of Fuel per B. H. P.	Cost of Labor, Three Months.	Cost of Supplies, Three Months.	Cost of Supplies & Labor, per K. W.	Cost of Supplies & Labor, per B. H. P.	Total Cost per K. W., All Charges.	Total Cost, per B. H. P., All Charges.
Manhattan Transit Co., N. Y.	150	84	12½	2,040	33⅓	84,000	..	9,550	4c.	$382.00	4.54 mills	..	$672.00	$60.00	8.7 mills	..	1.32c.	..
American Locomotive, R. I.	75	72	17¾	1,284	90%	..	84,460	5,460	4c.	218.40	..	2.58 mills	216.00	42.00	..	3 mills	..	5.58 mills
Jewett City, Ct.	150	84	15	1,260	25%	33,356	..	5,268	4c.	210 72	6.3 mills	..	273.00	59.00	1c.	..	1.63c.	..
Wm. Cramp & Sons, Pa.	75	72	10	720	33⅓	12,550	..	1,944	3c.	58.32	4.65 mills	..	72.00	37.50	8.7 mills	..	1.33c.	..
American Ordnance, Ct.	75	72	9	648	50%	..	19,440	2,016	3½c.	70.56	..	3.63 mills	72.00	36.00	..	5.55 mills	..	9.2 mills
American & British, R. I.	225	72	9	648	90%	..	129,960	10,062	5c.	503.00	..	3.9 mills	216.00	144.00	..	2.77 mills	..	6.67 mills
Ellis Mfg. Co., N. J.	75	72	9	648	33⅓	..	16,848	1,584	3c.	47.52	..	2.83 mills	72.00	36.00	..	6.4 mills	..	9.23 mills
S. Pacific R. R., Tucson, Ariz.	75	72	10½	756	66⅔	..	37,800	2,808	1¾c.	49.14	..	1.3 mills	90.00	33.00	..	3.25 mills	..	4.55 mills

Detail cost of operation for eight Diesel engine plants for three months ending January 1, 1904.
Cost per kilowatt equals cost on switchboard.

The cost of fuel per kilowatt-hour varies from 4.65 mills at average load of thirty-three per cent and three-cent oil, at William Cramp & Sons to 6.3 mills per kilowatt-hour on switchboard, with four-cent oil and average load of twenty-five per cent at Jewett City, Ct. In this case the plant carries full load for a short time and then runs from 11 P. M. to 7 A. M., with only twelve and one-half kilowatt load or twelve and one-half per cent of rated capacity.

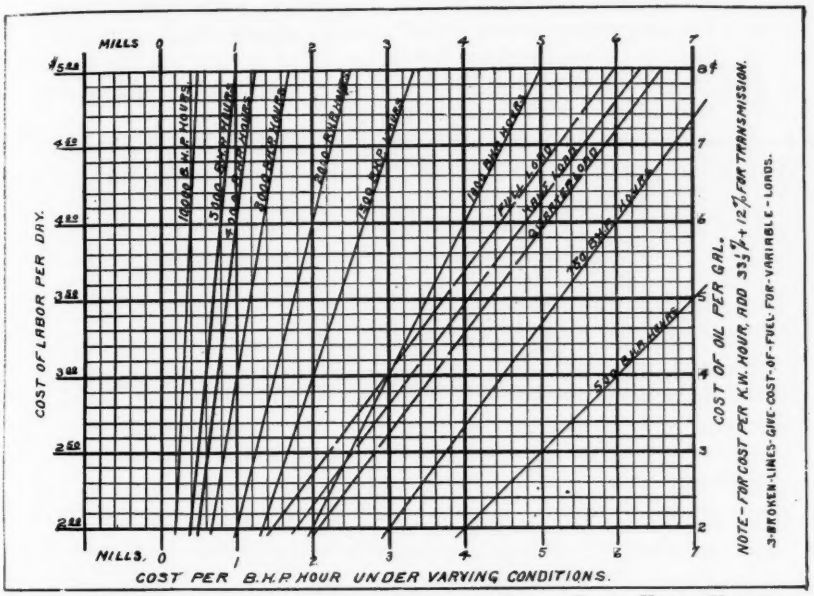

MILLS
COST OF LABOR PER DAY.
COST OF OIL PER GAL.
NOTE—FOR COST PER K.W. HOUR, ADD 33⅓% + 12½% FOR TRANSMISSION.
3-BROKEN LINES GIVE COST OF FUEL FOR VARIABLE LOADS.
MILLS.
COST PER B.H.P. HOUR UNDER VARYING CONDITIONS.

FIG. 1.—COST OF OPERATING INTERNAL COMBUSTION ENGINE PLANT UNDER VARYING CONDITIONS OF LOAD.

The labor charges per brake-horse-power or kilowatt on all these plants vary of course with the total output per day, the nearer they are to full capacity (as at American Locomotive Works, 3.1 mills per brake-horse-power) the lower the cost, while in the case of Jewett City, with an average of only twenty-five per cent of full load, the charge of these items is one cent per kilowatt-hour.

The automatic consumption of fuel and the close approach of this consumption to the variable load render it comparatively easy to compute the exact cost of operation when all the following data are known and the diagram Fig. 1 and Fig. 2.

Fig. 1 determines the cost of operating a Diesel engine plant under varying conditions of load, when the following data are known:

1—Size of plant in brake-horse-power capacity.
2—Average condition of load.
3—Cost of oil per gallon.
4—Cost of labor per day's run.
5—Cost of lubrication, etc.

As for example suppose we have a plant of 600 brake-horse-power running at one-half load, ten hours per day, with labor at $3 per day and supplies at $1 per engine per day. Fuel oil at four cents per gallon.

Referring to the diagram we find that with oil at four cents per gallon the fuel at one-half-load will cost 3.3 mills per brake-horse-power-hour.

With $3 for labor and $2 for supplies and 3,000 brake-horse-power-hours per day, this charge amounts to 1.7 mills per brake-horse-power-hour.

From the above we get the following results:

	Mills per Brake-Horse-Power-Hour.
Cost of fuel	3.3
Cost of labor and supplies	1.7
Total cost	5.0

Or 6.66 mills per kilowatt-hour at engine, and assuming twelve and one-half per cent loss in transmission, would cost 7.5 mills at switchboard.

Fig. 2 is intended to determine the cost of coal per indicated horse-power, brake-horse-power or kilowatt-hour.

Assuming, as in the Diesel engine case, a plant of 600 brake-horse-power, running at one-half-load with four pounds of coal per brake-horse-power at this load. Coal at $3 per ton delivered, and labor charge of $3 for engineer, $2 for fireman and $2 for supplies, or $7 per day of ten hours, we find cost of

	Mills per Brake-Horse-Power-Hour.
Coal	6.0
Labor and supplies	2.4
	8.4

or

1.12 cents per kilowatt-hour on engine.
1.26 " " " switchboard.

The saving in the Diesel engine would be equal to 5.1 mills per kilowatt-hour on switchboard, or for 1,968 kilowatts per day × 308 days = 606,144 kilowatts × 5.1 mills = $4,324 per year.

Had these plants been running at full load and assuming three and one-half pounds of coal for steam engine per brake-horse-power-hour, the relative cost on switchboard would have been

	Mills per Kilowatt on Switchboard.
Steam	9.68
Diesel	5.77
Saving by "	3.91

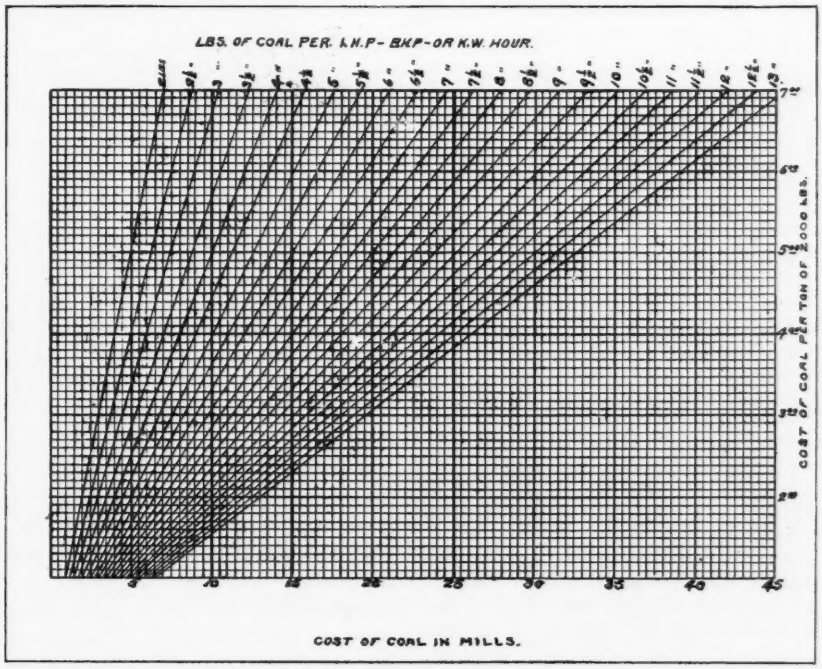


FIG. 2.—THE COST OF COAL PER INDICATED HORSE-POWER, BRAKE-HORSE-POWER OR KILOWATT-HOUR.

Or per year of 1,212,288 kilowatt-hours would make a saving of $4,740.00.

The above calculations show that as the steam engine approaches its full capacity the difference per kilowatt cost between that and the internal combustion engine becomes less, while at partial load the latter has its greatest advantages, and as this condition prevails in small lighting plants the engine best suited to the load will give the highest economy.

In a plant of 100 brake-horse-power, assuming for steam seven pounds of coal per brake-horse-power at one-half load or six pounds of coal per brake-horse-power at full load, and coal at $3 per ton, with $4 for labor and supplies for steam, and $3 for Diesel, the results would be about as follows:

HALF LOAD—STEAM.

	Cents.
Coal	1.1
Labor & supplies	0.8
	1.9 per B.H.-P.hr.
	2.53 " Kw. "
	2.84 " " " on sw'hb'd

HALF LOAD—DIESEL (OIL AT FOUR CENTS PER GALLON).

Oil	3.4 mills.
Labor & supplies	6.0 "
	9.4 " per B H.-P.hr.
	1.25 cents " Kw. "
	1.41 " " " " on sb'd

A saving in favor of Diesel of 1.43 cents per kilowatt-hour on switchboard.

FULL LOAD—STEAM.

Coal	9.5 mills per B H.-P.hr.
Labor & supplies	4.8 " " " "
	1.35 cents " " "
	1.80 " " Kw. "
	2.03 " " " on sb'd

DIESEL.

Oil	3 mills per B.H.-P.hr.
Labor & supplies	3 " " " "
	6 " " " "
	8 " " Kw. "
or	9 " " " " on sb'd

A saving of 1.13 cents per kilowatt-hour on switchboard.

The consumption of coal is for brake-horse-power and not for indicated horse-power, and is based on the average economy of the plant per year in the hands of the average operator. No doubt somewhat better results could be shown in a manufacturer's test, but are never secured under average working conditions, especially with the cheap grades of coal that gradually supercede "picked combustible," and the above figures for coal consumption are lower than in a majority of plants of the size mentioned, especially if running non-condensing.

Assuming that these comparisons were made on plants located in New England and with the present cost of fuel, *viz.*, coal $4.50 a ton delivered for bituminous and oil at four cents a gallon in tank cars.

The fuel cost of the smallest Diesel plant would be no greater than that of a steam plant using one pound of coal per brake-horse-power-hour, which has never been reached in a steam engine of any size or type. Even then such a steam plant would show practically no economy on variable load, with a decided advantage for the internal combustion engine, to which should be added the saving in labor.

THE LITHOTYPE.

A DEVICE FOR MAKING LITHOGRAPH BOOK PLATES WITHOUT THE USE OF MOVABLE TYPE.

Within recent years there have been devised several successful machines for effecting quick composition of type matter for book-printing. These machines have been successful because they have cut down the time of hand composition and have given to the publisher the use of a clean-cut letter for each new piece of work. Up to date those machines which have met with the greatest success for this kind of work have employed a matrix in some form or other for the casting of type faces in intaglio or relief.

The machine which forms the basis for the description in the present article is a radical departure from this form of type casting, and while it employs cast type letters, these perform only a minor function in the development of the finished product.

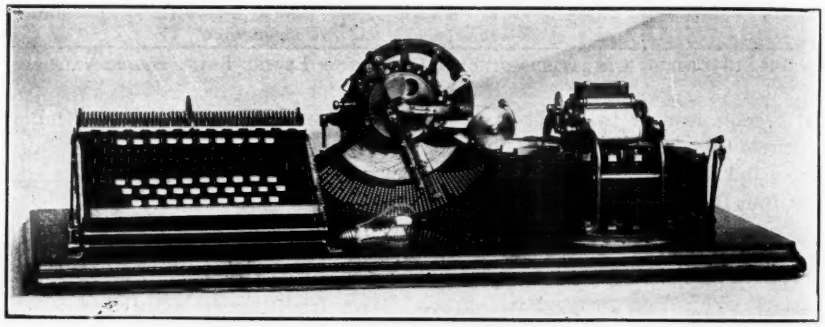


FIG. 1.—THE KEYBOARD, JUSTIFIER AND PERFORATOR, THE PRIMARY ELEMENT OF THE LITHOTYPE. THE MACHINE WORKS ON A 110-VOLT LAMP CIRCUIT.

The system depends upon the art of lithography for its successful operation. It might be well at this point to explain that in lithography the prints are taken from a plane surface, and the operation depends upon the well-known repellent action which takes place between a grease substance and water. In brief, an impression is made with a grease substance upon a plane surface, properly prepared, and this, of course, repels all moisture. The contiguous parts of the plane surface which have not been greased are of such a nature that they absorb and hold moisture, so that the action is reciprocatory, in that the plane surface accepts no grease substance where there is moisture, and where there is a grease substance deposited the plane surface accepts no moisture.

The apparatus is well shown in the accompanying illustrations. Fig. 1 shows the primary element of the system. This consists of a keyboard on the left, a series of radially arranged electromagnets and a perforating device on the right, and a justifying apparatus in the centre. Immediately below the keyboard is a bank of mercury cups. As a key is depressed, one or more contacts are forced into mercury cups, and these, through the proper connections, actuate one or more of the electromagnets, which cause the perforating device to puncture the sheet of paper which is seen at the right of the illustration.

One of the greatest difficulties in all mechanical type-setting machines has been in the proper justification of the line, so that there would be an even spacing between the words, and perfect alignment of the assembled lines. This machine overcomes this difficulty in a unique and ingenious manner. Each character and space is given a certain unit dimension, so that a line of N units length can contain only so many characters and spaces. As each key is depressed and a proper perforation made, a solenoid at the rear of the justifying element of the machine actuates a pawl and ratchet, which causes the radial arm shown to move in a predetermined direction. By a series of three movements, a simple mathematical formula is introduced, as follows: let N equal the number of units in the line, N′ the number of letters used in assembling the line, and N″ equal the number of spaces between the words. Then $\frac{N - N'}{N''}$ gives the amount of extra space which must be added between each word to properly fill out the line.

As the assembling of the letters and spaces which go to make a complete line nears the end of the unit length, this arm is carried over a series of plates and contacts, performing the functions of addition, subtraction and division; and the perforation corresponding to this increment is the last perforation which is made for that line.

Fig. 2 is a reproduction of a perforated sheet of the paper. It will be noticed that

there is a continuous series of perforations at the extreme edges. These perforations are so arranged that they are always in step with the character perforations, so that in the reproducing mechanism the roll of paper will only have such movement at any time as will bring the reproduced characters into their proper adjacent positions.

Any length of the sheet of perforated paper can be taken from the perforating machine and carried to the reproducing machine, which is shown in Fig. 3. This machine carries upon a rotatable shaft a type sleeve, shown in Fig. 4. One-half of this type sleeve is occupied by the letters in relief, the corresponding series of holes diametrically opposite being used for engagement with a pin, which makes the type sleeve absolutely free from all vibration during the printing movement.

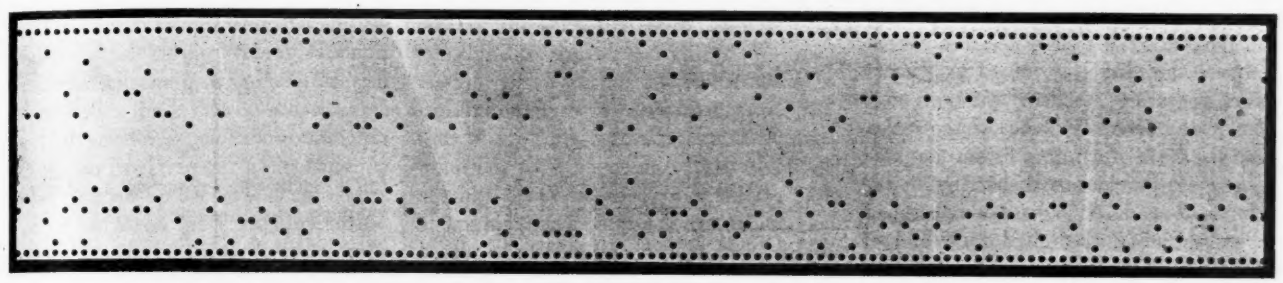


FIG. 2.—THE PERFORATED SHEET AS IT COMES FROM THE PRIMARY APPARATUS. THIS STRIP IS ONE-HALF ACTUAL SIZE.

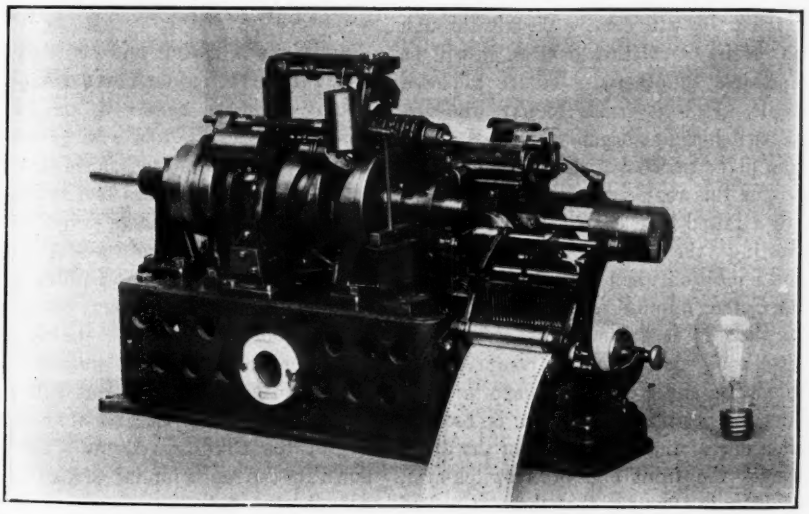


FIG. 3.—THE PRINTING APPARATUS. THE MACHINE IS FITTED WITH A REGULAR EDISON SOCKET AND RUNS ON A 110-VOLT LAMP CIRCUIT.

At the extreme right of the machine shown in Fig. 3 will be noticed a sheet of perforated paper which is being fed from a roll which has been deposited in its proper receptacle. Immediately above the paper, and back of the tractive roll, is a series of platinum contacts under spring tension. Just below these contacts is a series of mercury cups leading to proper electrical connections. It can be readily understood that wherever there is a perforation and this series of contacts is impressed on the paper, contacts will be made only where the platinum point can reach the mercury globule. Where there is no perforation there is a perfect paper insulation.

After the sheet of perforated paper has been properly adjusted and the type sleeve set upon its shaft, the reproducing machine is ready for work. Upon the shaft which carries the type sleeve, for half of its circumference and for about one-half of its length, there are arranged a number of lugs, helically disposed, corresponding to the number of platinum contacts above the perforated sheet. As the perforations at the extreme ends of the sheet make contact with the guide wheels and tractive roller, they throw into operation a mechanism which causes the frame carrying the series of contacts to be lowered. As was stated before, the perforation which would determine the amount of extra spacing to be applied between each word was the last puncture made on the perforated sheet. In reproducing, this becomes the first contact made, and determines the extra lateral movement of the type sleeve in spacing. Accordingly, then, as other perforations come underneath the platinum contacts, allowing current to flow into the corresponding electromagnets, other stops are raised so as to intercept one of the lugs on the type sleeve shaft, which regulates the rotating motion of the type sleeve. A simultaneous motion projects a pin, which engages in a hole diametrically opposite the character corresponding to the perforation through which contact has been made, and fixes the type sleeve in a rigid position. The next movement is that of a tiny roller carrying lithographic ink, which, under the proper mechanical movement, rolls over an inking surface and, in turn, over the character from which a print is to be taken. Immediately in front of the type sleeve is a sheet of "transfer" paper. This is a paper which has been prepared with a solution of starch and glycerine, and which holds the grease impression very tenaciously and without slurring. As the inking roller returns to its normal position, the transfer paper is carried forward until it comes in contact with the letter which has been inked. Another mechanical movement then carries forward a light lever arm, upon the end of which is a hammer which presses lightly and evenly against the back of the transfer paper, taking the imprint of the latter.

In addition to the electromagnetic apparatus the mechanical features are worthy of an extended description. There are a number of devices for regulating the speed, for stopping the machine in case of accident, for effecting the movement of the type sleeve absolutely without vibration, and for performing various other functions of the operation. Without taking up at all the value of the apparatus as a competitor for other forms of machines for rapid composition, the work which it is doing at the present time is all that could be expected. The impressed characters are clear-cut, and after the transfer paper has been properly applied to the aluminum or stone—whichever may be used—and this surface treated in a manner well known to the art, large numbers of copies can be taken with perfect results.

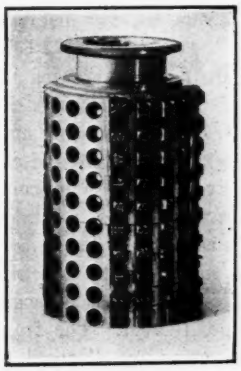
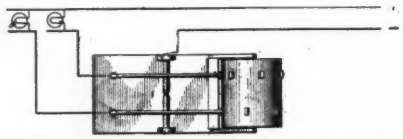


FIG. 4.—THE TYPE SLEEVE.

The inventor of this machine is Mr. W. S. Timmis, and it is being constructed by the Timmis Lithotype Company, of New York city.

Electrical Patents.

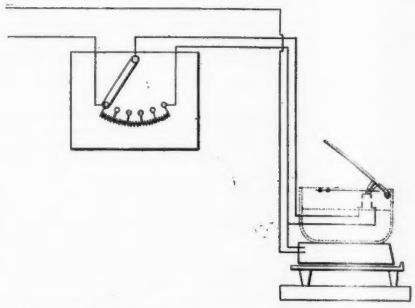
An automatic electric switch has been devised and patented by Mr. William S. Guthrie, of Terrell, Tex., the object of which is to produce a switch apparatus embodying a series of switches and a rotary switch-operating member common thereto and arranged to be driven by a motor of suitable character to effect the operation of the switches in any desired sequence or order, the various elements of the apparatus being combined in a simple, compact and durable form. The primary switch-operating member, which is common to the several switches of the series, is in the form of a rotary drum, mounted on a shaft provided with bearing in the bifurcated end of a suitable base or switchboard of any desired form and of suitable non-conductive material. The drum is provided upon its periphery with suitable means, for instance, circumferential series of lugs or projections for effecting an intermittent operative connection between the drum and a series of movable switch-arms mounted on a switchboard. The projections of each circum-



VIEW OF SWITCHING APPARATUS WITH TRANSLATING DEVICES.

ferential series are designed to be successively presented to a switch-arm through the rotation of the drum, rotary movement being imparted to the latter by any suitable means, as, for instance, a motor geared to the drum, as by a belt. The switch-arms are pivotly mounted intermediate of their ends, and while the particular character of this mounting may be varied within certain limits, the switch-arms are preferably provided with comparatively long bearing-sleeves, rotatably carried by a shaft, common to the several switch-arms, and supported by brackets upstanding from the base at or adjacent to the opposite sides thereof. The front ends of the switch-arms are disposed in close proximity to the drum for engagement with the lugs, and the rear ends of the arms are disposed above contact members in the form of vertically yielding binding-posts, extending upwardly through openings in the base. The rear end of each switch-arm is normally held in an elevated position out of contact with the adjacent post by a spring mounted in any suitable manner, but preferably secured to the base, and having its upper free end-bearing against the underside of the switch-arm. Each contact member or post is provided at its lower end below the base or switchboard with an enlarged head, limiting the upward movement of the post under the impulse of a spring, secured at one end of the bottom of the switchboard and bearing at its free end against the underside of a binding-screw, screwed into the head of the post and serving to retain electrical connection therewith one of a series of feed wires, leading respectively to translating devices of any suitable character, the devices being preferably provided with a common return wire. The several switch-arms are in constant electrical connection with the main feed of line wire, between which and the common return is located a suitable source of electrical energy, designed to be placed in circuit with the translating devices by means of the switching apparatus. The manner of effecting the electrical connection between the line wire and the several switch-arms is susceptible of variation, but a simple and efficient arrangement comprehends the attachment of the wire to one end of the shaft by a binding-screw. The shaft, the sleeves and the switch-arms are constructed of suitable conductive material, and the drum, as well as the switchboard or base, is of non-conducting material, so that while the contact of one of the switch-arms with one of the posts will close a circuit through one of the translating devices, it will be impossible to otherwise secure a closed circuit. It is desirable to have the several switch-arms normally disposed in the same plane parallel with the switchboard and for this reason the latter is provided with a raised bead constituting a stop for arresting the several switch-arms in proper position when the latter are swung under the impulse of a spring. The operation is as follows: the several circuit-closing devices, each comprising a switch-arm and a contact member or post, being in position, the drum is rotated. When one of the projections on the drum engages the front end of a switch-arm, the latter is swung so that the rear end of the switch-arm comes into contact with the subjacent contact element or post to close the circuit through one of the translating devices. As the drum continues to rotate, the switch-arm will continue to move until it reaches its disengaging position, this further movement of the arm after the circuit is closed being accommodated by the yielding of the post against the resistance of the spring. The projection having passed the end of the switch-arm, the arm will be restored to its normal position by its spring, thus breaking the circuit previously closed. As the rear end of the arm is moved away from the post, the latter will be elevated by its spring until arrested by the contact of the head with the underside of the switchboard.

Mr. Jas. L. Ayer, of Cambridge, Mass., has assigned to the Simplex Electric Heating Company, of Boston, Mass., a patent obtained by him on an apparatus for controlling current-supply to tools. The invention has for its object the provision of means for supplying varying amounts of current to a tool or similar device under different conditions, according to the requirements. In the preferred embodiment, a rheostat is provided on the wall or other convenient place in series with a line wire provided with a handle connected by a wire to the tool handle, whose contacts

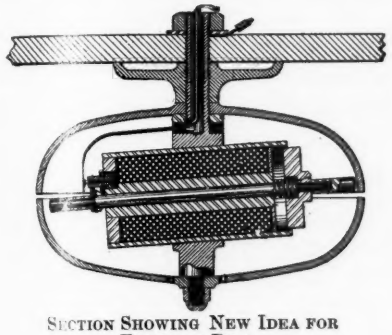


DEVICE FOR CONTROLLING CURRENT SUPPLY TO TOOLS.

(carried by a spring and actuated by a lever) upon being depressed complete a circuit from the handle by means of a wire leading to the tool with an opposite line wire. By this mechanism it will be seen that so long as the tool remains in use, and hence the handle switch held in operative position, the rheostat will be more or less in circuit, according to the position of the rheostat-arm; but as soon as the tool is placed on the stand or whenever it ceases to be grasped by the operator, the entire rheostat will be in series with the tool, because of the breaking of the auxiliary circuit. This cuts down the current supplied to the tool, but permits the full heating current to be supplied when required for use. By having a sectional rheostat, the tool may be operated with any portion of the rheostat desired, so as to vary the amount of current according to the different kinds of work.

An electric bell which is simple, inexpensive and novel, as regards construction, has been invented by Harry E. Dey, of New York city, N. Y. This bell comprises a magnet saddle, a pair of resonant members carried by and arranged

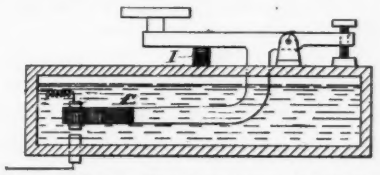
substantially at right angles to the axis of the magnet saddle, and an electrically controlled striker arranged transversely of and at an inclination to the axis of the magnet saddle, the said resonant members serving to substantially enclose the magnet saddle and striker and the said striker having a line of reciprocating movement extending obliquely from one of the resonant members to the other and being adapted to engage in its movements the respective resonant members. In carrying out his invention, Mr. Dey employs a magnet saddle in the form of an annulus or ring, having a primary shoulder terminating in a reduced extension, the latter aligning with the axis of the bell proper, and a secondary shoulder is located diametrically opposite the primary shoulder and terminates in a reduced extension. An electromagnet is disposed



SECTION SHOWING NEW IDEA FOR ELECTRIC BELL.

within the saddle, comprising a core, opposing discs supporting the core, a coil on the core intermediate of the discs, and an exterior casing or sleeve, the latter serving as a general tie member for holding the foregoing parts firmly in their respective positions for service and with the discs fully enclosing said coil. One of the discs is preferably of steel and serves as a yoke for the electromagnet, while the other disc is of non-magnetic material. A striker, preferably of non-magnetic material and in the form of a rod, is employed, the striker extending longitudinally through the magnet core. The striker carries an armature which, under normal conditions, is located adjacent to one pole of the magnet, the opposite pole of the magnet being formed by the casing or sleeve. An elastic element is interposed between the armature and the electromagnet proper, the element being in the form of a spiral spring encircling the striker. A leading-in wire runs downwardly within the reduced hollow extension, the wire contacting at its lower extremity with a contact member formed from metal and supported at the primary shoulder. The lower extremity of the wire leads from the interior of the extension outwardly by way of a lateral opening with which the extension is provided. The contact member of the leading-in wire makes connection with a post, extending through one of the discs and insulated therefrom by means of a bushing to connection with the inner end of the coil, the other end being grounded to the main magnet in suitable connection with which a leading-out wire is employed. The free end of the contact member terminates in the line of movement of a non-magnetic catch in the form of a washer fixed to or upon the adjacent end of the striker. Between the catch and the electromagnet proper an elastic element is interposed in the form of a semi-elliptical spring. Platinum contact points are employed, one at the free end of the contact member and the other at the outer end of the post, and the striker is provided with service tips, one at each end. In connection with the bell, one or more resonant members are used, varying in pitch or tone where a chime effect is desired. The members are dished or cup-shaped and open one toward the other and substantially enclose and house the operative parts of the bell, and thus protecting the same against injury. One of these members is located at the secondary shoulder and the other at the primary shoulder with an intervening washer. These members are each preferably provided with a central threaded opening, so that one member may be seated at the secondary shoulder by means of the threaded extension and held there by means of a nut, and the other member may be seated at the primary shoulder by means of the threaded extension and held by means of a keeper, which is adapted to have a threaded engagement with the extension after the manner of a nut, and which serves also to duly space the bell from its supporting medium. In connection with the bell, a battery or other suitable current or electric generator and a push-button or other device is employed in circuit with the leading-in and leading-out wires, as in common practice. In operation the circuit being closed by manipulating the push-button, the striker receives a reciprocating movement, for the reason that the electromagnet of the bell attracts the armature which, being fast on the striker, causes the latter to move longitudinally and rapidly in one direction against the tendency of the elastic element, during which movement of the striker the catch engages the free end of the resilient contact member and urges it away from the post, thus breaking the circuit at that point, whereupon the striker sustains a forcible thrust in the opposite direction through the medium of the elastic element, thereby causing the catch to recede from its engagement with the free end of the member and permitting reestablishment of the circuit through the return of the free end of the member to engagement with the post. Then the armature is again attracted by the magnet of the bell, and this operation is continued so long as the circuit is closed, and a reciprocating movement is thus imparted to the striker. The elastic elements yieldingly hold the striker out of contact with both of the resonant members. When the striker is moved under the attractive force between the magnet of the bell and the armature its tip engages and quickly recedes from one of the resonant members and on the return movement of said striker its other tip engages and quickly recedes from the other resonant member, thus, where the two resonant members vary in tone or pitch producing a chime effect. However, if desired, the bell may have the character of a single-gong bell.

Mr. Lee De Forest, of New York city, has invented a wireless signaling apparatus by which, with a Morse key modified in accordance with his invention, the same speed may be obtained in wireless signaling as in ordinary telegraphy. In carrying out his invention, Mr. De Forest employs a pivoted key lever having two arms. This lever is of bent or re-



MODIFIED MORSE KEY SIGNALING APPARATUS.

curved form, the contact-arm of which is at a lower level than the operating arm, so that the contact-arm may be immersed in oil or other insulating fluid or dielectric having a higher insulating capacity than air and contained in a box or reservoir upon which the key lever is mounted. A contacting member is carried by the contact arm of the key lever and another contact member is mounted on a reservoir. The terminal portion of the contact-arm is composed of an insulating material, as hard rubber, within which is mounted a metal plug forming the first-mentioned contact member. The two contact members are respectively connected with wires which form parts of the key-controlled circuit. A spring is employed to raise the key after it has been depressed and an adjustable stop determines the amount of the rise.

Reviews of Current Engineering and Scientific Literature.

Does the Radioactivity of Radium Depend Upon Its Concentration?

This is a communication from Mr. E. Rutherford, describing some recent investigations which he has carried out, in order to determine whether the radioactivity of radium depends upon its concentration, a possibility suggested by Dr. J. J. Thomson. In order to test this point, measurements of the radioactivity of radium bromide were made when in the solid state and when diffused throughout the mass of a solution more than a thousand times the volume occupied by the radium compound. Two tubes, closed at one end, were taken. In one was placed about a milligramme of pure solid radium bromide, and in the other a solution of radium chloride. The tubes were connected near the top by a cross tube, and the open ends sealed. Measurements of the radioactivity were made with an electroscope, the tubes being fixed in a definite position. The apparatus was then tilted so as to allow the radium chloride to flow into the arm containing the radium bromide, which was dissolved. No appreciable change in the radioactivity was observed in over a month's interval, and the conclusion is drawn that a distribution of the radiating matter over a few times its original volume has no appreciable influence on its radioactivity. The radioactivity of radium is therefore not influenced by its own intense radiations. This result is in agreement with previous observations. It is thus improbable that the energy given off by radium is due to the absorption of an unknown external radiation, similar in character to those which are emitted.—*Abstracted from Nature (London), January 7.*

Unscientific Electric Engineering, Destruction of Underground Pipes, Etc.

Electrical research, says Mr. H. W. Spang, has principally been confined to the laboratory, which has resulted in the rapid development of electric generators, motors and all other electrical appliances. In fact, the advance in electric generation has been far more rapid than the determination of the means for safely employing power for electric energy. Owing to the strict adherence to laboratory deductions, the engineering branch of electrical science is defective, which partially accounts for the great destruction of property, underground pipes, etc., by power currents. Ohm's law, governing electric action, is simply a laboratory deduction. The law of shunts, which the trolley current is supposed strictly to observe, is also a laboratory deduction. A grave blunder has been made by the electrical engineer in neglecting to investigate thoroughly the true action of ordinary electricity in connection with underground pipes. Had this been done, the so-called electrolysis problem would, no doubt, have long since been solved. The author gives a rambling discussion of atmospheric discharges, lightning, and what he calls "underground lightning currents." He dwells upon the great grounding tendency of electric currents, even with a very low potential current, as though the earth had an affinity for electricity drawing it into itself on all occasions. He cites many cases where pipe systems have been destroyed, attributing the injury to the underground lightning currents. In regard to electrolysis, due to railway currents, he does not think that the trouble is due to poor ground returns. He does not believe in insulated joints for pipe systems, nor in conduit systems, nor in double trolley systems, as, according to his idea, the electricity will go into the pipes anyhow. No means is suggested for avoiding the dangers which he believes exist, but he concludes that the present unsatisfactory status of the electrical business calls for a general electrical and lightning protection system for cities, towns, villages, and even the suburban districts.—*Abstracted from the American Gas Light Journal (New York), January 18.*

A New Electric Traction System.

The peculiar condition of Switzerland has for some time drawn the attention of the authorities there to the advisability of adopting some form of electric traction system for operating the steam railroads, because Switzerland, while it has abundant water power, has no coal mines, and the steam railroads are at the present time entirely dependent upon imported coal. To convert these roads completely to electric traction would necessitate a large expenditure, and it is therefore desirable to make use, as far as possible, of the present apparatus. Herr E. Lenggenhager describes in this article a novel solution of the problem, which he states is now being studied by the government officials. In the system proposed the steam locomotives are to be retained, but steam is to be raised by means of electric heaters placed in the locomotive boilers, current for which is to be supplied by an overhead trolley, from suitable power stations, utilizing water power. The type of heater suggested is a thin conducting layer, surrounded by protecting plates. These heaters are to be arranged in vertical rows in the boiler, and a suitable arrangement of switches in the locomotive cab will enable the heat to be controlled. This arrangement, it is said, will enable steam to be raised to a pressure of fifteen kilogrammes per square centimetre from water with a temperature of ten degrees centigrade, in three hours. The electric heaters will have a practically perfect efficiency, but there will be some loss, due to radiation from the boilers. A locomotive requiring 100 kilogrammes of steam per hour would require 225 kilowatts. The following arguments are given for adopting this system: the cost of the change will be small. It will be easy to instruct the present train crews in the use of the new devices. The only change necessary in the locomotive will be the use of a current collector in place of the smokestack, and the addition of the heaters and switches, with indicating apparatus. The transformation can be quickly made, and as the locomotives are condemned, they can be replaced by electric locomotives.—*Translated and abstracted from the Elektrotechnischer Anzeiger (Berlin), January 7.*

The Vogt Gas Engine.

A novel type of gas engine, which is, according to Mr. H. A. Humphrey, possessed of a number of distinct advantages over the usual type, is here described by him in some detail. The most radical departure from the usual practice is the filling of the working cylinder with water. This cylinder is horizontal and opens at each end into two chambers, also filled with water. At the upper part of these chambers the air and gas are admitted. After an explosion has taken place in one chamber, the gases force down the water contained in it, and thus move the piston horizontally. At the end of the working stroke an air valve opens, admitting air under pressure, which drives out the products of combustion. On the return stroke the air valve closes, as does also the exhaust valve,

and part of the water in the chamber is ejected through a special valve. The gas valve opens, admitting gas under pressure. Compression begins, the gas valve closes, and the compression of air and gas goes on. At the end of compression the mixture is exploded, and the cycle is repeated, the same process being carried on in the other chamber. This method of operation gives two impulses per revolution. The power of the engine is controlled by stopping the escape of air from the cylinder on the return stroke, and by the amount of gas admitted and the quantity of water allowed to escape. The proportion of air and gas is constant for all loads. The presence of water in the cylinder enables the piston and stuffing boxes to be kept tight without much friction, as they are under water. It does away with the necessity of a water-jacket for cooling the cylinder, and prevents unequal expansion between the piston and the cylinder. At the end of each stroke a little fresh water is admitted to the cylinder, and part of the hot water is drawn off. As the gas does not come in contact with the working cylinder, it is not necessary that it should be clean. Any dust or soot will be carried off in the water. Tests of a small engine giving but one and three-quarters horse-power are said to have shown a consumption of gas of only sixteen to eighteen cubic feet of London city gas per horse-power—a performance as good as that of a 200-horse-power gas engine of the ordinary type. Calculation shows that the speed of the piston may be five or six metres per second before the water column will be broken up. Four metres per second is generally high enough for the piston speed of a gas engine. It is stated that a 1,000-horse-power engine is to be built, in order to test the capabilities of a large machine of this type.—*Abstracted from Engineering (London), January 8.*

The Bristol, England, Switchboard Fire.

This is a contribution by Mr. H. W. Clothier, discussing the causes of the breakdown at the Bristol station on December 23 last, and suggesting conditions which might have saved or reduced the extent of the damage. The primary fault is not known at present, but this caused an excess current through the machine fuses, the failure of which developed an arc on the switch gear, which spread to the cables and the switchboard platform and roof. Some time was required to shut down the machines, to extinguish the fire, and to obtain light for examining the extent of the damage and clear away the debris and make temporary connections. In the mean time the Avonbank station, containing a sound equipment, was standing idle and helpless. The conditions which might have saved the station are as follows: the obsolete type of fuse should have been replaced with a later design, or dispensed with altogether. Less inflammable material might have been used on the floor and on the cables. Metallic sheathing on the cables would have prevented the possibility of the insulation burning to the extent that took place. The floor might have been made of non-inflammable material, such, for instance, as glass. The same suggestion may be made in regard to the roof. The time spent in extinguishing the fire could not be avoided, except by preventing the fire in the first instance; but the inconveniences caused by the absence of light could be avoided by the systematic installation of flare lamps or acetylene lamps, so that they could be lit up immediately in case of trouble. Although triplicate bus-bars had been introduced as a provision against failure, they were of little service in an emergency. The full advantages during and after an emergency are only to be derived by the complete duplication of all parts. To cope with a failure of the magnitude that the one in question attained would necessitate a duplication of the entire switch gear, but this gear might consist of the barest necessities for temporary use. The use of fuses on the generator is theoretically bad, because sound machines are likely to be isolated at the wrong time. If used at all they should be fused to blow at two or three times the working capacity of the generator. The size of fuse can not be determined by the capacity of the individual generator, but should be based upon the total capacity of all the generators running in parallel. A reliable reverse current automatic circuit-breaker does not seem to be available at present. It thus seems better not to depend upon automatic protection, and then, if a fault occurs on a generator and the attendant does not pull out the main machine switch, the engine will possibly be pulled up; but in any case, it is better to risk injuring the generator than to cause a cessation of the supply to the consumers. The remedy is brutal, but the trouble is soon over.—*Abstracted from the Electrical Times (London), January 7.*

The Gin Process for Producing Steel Electrically.

This article gives a general discussion of the use of electricity in producing steel, its advantages and disadvantages, and then proceeds to a description of the Gin process. In this method the furnace consists of a movable crucible, which can be run into an enclosed chamber in order to reduce the loss of heat during operations. The crucible has the form of a flat carriage, the upper surface being covered with some refractory material, such as chalk, and in which is formed a long channel, usually doubled back and forth so as to obtain a considerable length. In operation, this channel contains the material to be worked. A heavy current is passed through the molten material by means of two heavy iron electrodes placed at the two ends of the channel. These electrodes are brought into contact with the conductors supplying current when the crucible is in the chamber. To prevent fusion of the terminals, water is circulated through them. In this method the necessary heat is developed in the material itself, it acting somewhat as an incandescent lamp filament. A decided advantage of the system is the doing away with carbon electrodes, and thus rendering purification of the steel simpler. To put the furnace into operation the crucible is run into the chamber, and molten iron run into it through suitable openings in the roof of the chamber. The current at once begins to flow through the material, and by adding, as necessary, carbon and fluxes, the process of conversion into steel goes on. The reducing materials are added from time to time, and the operation watched. When conversion has been completed, the molten steel is drawn off through channels in the crucible. By localizing the heat in the material itself, temperatures not obtainable in the Martin furnace may be reached, and only enough carbon to effect the oxidation of the impurities and the reduction of the ore need be added. To determine the heat efficiency of the furnace, a hypothetical ore is assumed for convenience in calculation. The steps in the reduction of this are followed carefully, the amount of heat required in each being computed. The final result shows that to produce one kilogramme of steel requires 456 watt-hours, plus the loss due to radiation from the furnace. This radiation will vary with the temperature at which the material is worked. Curves are given showing the actual performance under various conditions. The author computes the total expenses of a plant operating with this system and producing 30,000 tons of steel per year. Working on the ore process, the cost per ton is $16.40. Reckoning on a mixed process, it is $16.60 per ton. He contends that these figures are not unduly optimistic, and that, under favorable conditions, the cost per ton of steel would be about $15.—*Translated and abstracted from L'Éclairage Électrique (Paris), January 7.*

INDUSTRIAL SECTION.

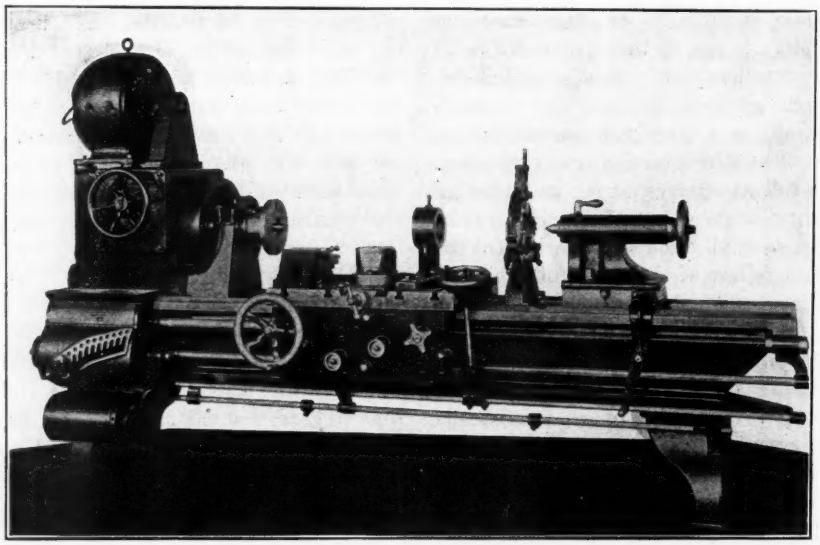
ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS.

A Twenty-four-Inch Motor-Driven Lathe.

The distinctive features of the Hendey-Norton improved screw-cutting engine lathe, here shown, are in the Norton system of speed-change gear, the reversing device by which the carriage may be moved in either direction, without reversing the direction of the spindle; the automatic stop which throws the feed at any predetermined point, and the interchangeable tool rest. This tool is built by the Hendey Machine Company, of Torrington, Ct.

The gear-changing arrangement consists of a cone of twelve gears secured by one key on the lathe screw or driving shaft, and a pinion sliding on a splined shaft and guided in the yoke of a rocker which carries at its outer end an intermediate gear always in mesh with the pinion, the whole being enclosed in a case which forms a cover for the gears, bearings for the screw and driving shaft, and a guiding slot with notches and detent holes for locking the mechanism in any one of its various positions. The sliding pinion, by means of the rocking intermediate gear, may be caused to engage with any one of the gears on the cone, the movement being controlled through the guiding slot of the gear box by a handle which carries a latch. The latter, when entering one of the holes of the upper row, secures the gears in a running position, the corresponding notch below serving to guide the handle, so as to bring the proposed combination of the gears into alignment before meshing takes place. The plate on the front is indexed to indicate the thread which the corresponding combination of gearing will cut. The regular equipment of gears allows for the cutting of twelve standard threads between six and twenty to the inch, or by the substitution of other stud gears the range may be shifted up or down, extending the limits to one and one-half and eighty to the inch. This device offers advantages of simplicity of construction, the saving of time and the avoidance of errors.

The reversing device is operated by a handle from the apron, and is also a time-saver, as by means of it the time ordinarily lost in reversing the lathe to reverse the carriage is avoided. The automatic stop, shown under the bed, may be set to limit the travel of the carriage in either direction. It obviates the danger of running into shoulders in turning and thread-cutting, or the bottoms of holes in boring and internal thread-cutting, and is especially valuable in duplicating pieces, since it makes but one measurement necessary. The interchangeable tool-rest feature allows the use of any one of four different styles of tool rest.



TWENTY-FOUR-INCH MOTOR-DRIVEN LATHE.

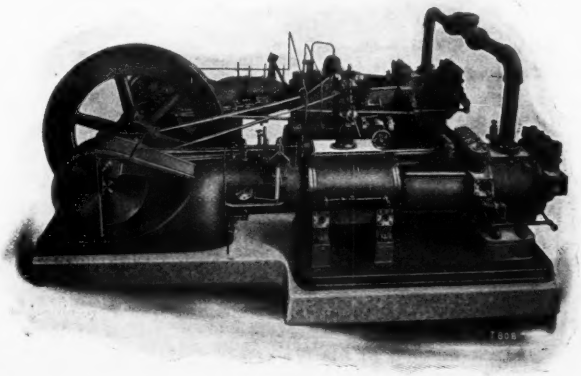
The driving element is a five-horsepower, low-speed, shunt-wound Crocker-Wheeler motor, supplied on the Crocker-Wheeler multivoltage system through a twenty-one point controller. A Morse chain transmits the power to a sprocket which may be connected direct to the spindle or through either of two back-gear combinations. The first combination gives a reduction in speed of 1 : 2.68, and through the second a further reduction in speed of 1 : 2.63 is obtainable. The highest speed of the motor is 1,270 revolutions per minute, and the corresponding speeds of the spindle 285, 103 and 40.4 revolutions per minute. The upper twelve speeds of the motor when driving the spindle directly, the same on the first gear combination, and the upper eighteen on the second, constitute the tool's working speeds, forty-two in all. Obviously the motor may be run on lower speeds, but there is no occasion to do so except with the slowest gear combination, where as low as four revolutions per minute of the spindle is possible. These extremely slow speeds are convenient when setting up work, or when a very low cutting speed is desirable. The controller is manipulated from a hand wheel supported on the carriage, the connection being through gears and a splined shaft, so that the motor is under instant control of the operator at whatever position along the bed the carriage may happen to stand.

The Compressed-Air Power Plant at the St. Louis Exposition.

From time to time there appear in various circulars and press notices data relating to the mechanical equipment of the power plant of the St. Louis Exposition. The apparatus which will be installed, both as purely exhibition apparatus, as well as for the performance of useful work, will, no doubt, be distinctive in design and operation. The Laidlaw-Dunn-Gordon Company, of Cincinnati, Ohio, will supply the central compressed-air power plant for the exposition. This plant will contain two main compressing units, one cross-compound two-stage Cincinnati-gear compressor, having thirteen and twenty-four-inch steam cylinders, twenty-two and fourteen-inch air cylinders and twenty-four-inch stroke, with a displacement at 125 revolutions per minute of 1,300 cubic feet per minute; and one cross-compound two-stage Meyer-gear compressor, having twelve and twenty-inch steam cylinders, eighteen and eleven-inch air cylinders and eighteen-inch stroke, with a displacement at 100 revolutions per minute of 530 cubic feet per minute. The first machine is to supply the general compressed-air requirements of the exposition, while the second is to supply the transportation exhibits. The larger ma-

chine is of special interest, as it is the first compressor of its type publicly exhibited, although a number of similar machines have been and are being installed in private plants. A 1,500-foot machine of this type is at the present time being placed in the Jersey City power-house of the Central Railroad of New Jersey.

The general construction of one of these machines is shown in the illustration. The frames are of massive construction, with a long bearing on the foundation, while the steam and air cylinders, joined in the direct line of thrust by heavy cast-iron housings, are also supported by bed-plates under their entire length, the weight of



One of the Compressors for the Central Air-Power Plant, St. Louis World's Fair.

each side being thus taken on two large bearing surfaces extending to the ends of the machine. The general construction is characteristic of the best grade of engine work, and comprises removable quarter boxes and main bearings, steel-forged connecting-rods, with wedge takeup, specially large crank and wrist pins and cast-steel crossheads with adjustable babbitted slippers, top and bottom, working in bored guides. The reciprocating motion is of the simplest possible character, this simplicity in construction permitting low reciprocating weights without sacrifice of strength. These features allow satisfactory balancing and, in connection with the long bearing on the foundations, ensure an especially easy running machine. The steam valve gear is of the four-valve type. Steam distribution is effected by means of short, double-ported, slide valves, working at either end of the steam chest on a valve face as close as possible to the cylinder bore, the port volume being restricted as far as the large valve area will allow. The exhaust valves are of the Corliss rotary type and are placed at the bottom of the cylinder. This construction has been followed in order to produce a valve gear having the essential advantages of a Corliss, namely, separate passages for the steam and the exhaust with corresponding reduction in cylinder condensation, together with short, straight ports and small clearance. On the other hand, the complicated Corliss releasing gear, which is necessarily prejudicial to even moderate speeds, has been eliminated, the action being positive throughout.

The air valve gear is, however, the distinguishing feature of this machine, combining in a very ingenious manner the positive action, noiseless operation and durability of the mechanically moved valve with the elasticity of the poppet valve. The noise and rapid wear of the poppet valve, due to the impact of the valve closing at the reversal of stroke, are eliminated by mechanically closing the passages underneath the poppet valve, and leaving a cushion of air upon which the latter seats.

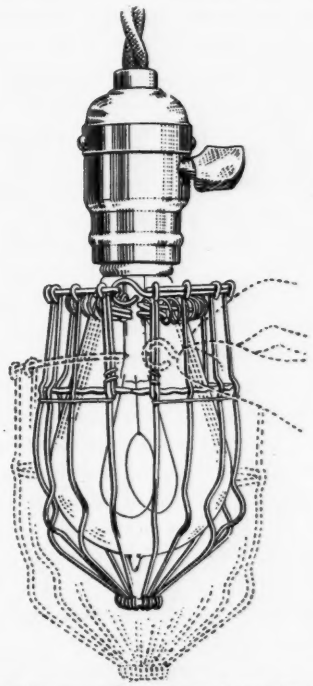
The Bucholtz Steam Turbine.

In the current issue of the London *Electrical Review* a brief description of a new type of steam turbine invented by Mr. Bucholtz is given by Mr. E. Kilburn Scott. The turbine consists of a series of brass discs or washers, half of them fastened to the case of the turbine, and the other half placed alternately and mounted on the spindle, the clearance between the plates being a fraction of a millimetre. In the fixed plates series of holes, arranged in concentric circles, are drilled straight through, with the drill at right angles to the plate. In the rotating plates there are similar series of holes drilled at a considerable angle with the plane of the plate. It will thus be seen that in passing through the holes from one end of the turbine to the other, steam is thrown against the slanting holes in those plates mounted on the spindle, thus making them rotate.

When the steam is passed through the rows of holes nearest the periphery, it works back through another series of holes nearer the spindle, and so on forward and backward until it finishes at the row nearest the spindle. There is no end thrust, and by reversing the direction of the steam the turbine is made reversible. Mr. Scott says that he has seen a machine of the size of two clinched fists at work doing one-quarter horsepower. It reversed beautifully and was an interesting example of how extremely simple a steam prime mover could be made. When worked as a reversible turbine the area of all the various rows of holes must, of course, be the same; but when the direction of rotation is always the same this objection can not be made.

New Type of Lamp Guard.

Mr. F. W. Winbolt, of the P. R. Wagor Manufacturing Company, 56 Harrison avenue, Springfield, Mass., has invented a new lamp guard which this company is preparing to place on the market. The unique features of this guard are its resiliency and convenience. In making a test, the guard, with a lamp in it, was dropped repeatedly three feet, striking on a hard floor, without putting either lamp or guard out of service. The method of placing this guard on the lamp is valuable to the contractor, as the manipulation is simple and great speed can be acquired. When in place it will stand a great deal of rough usage without being shaken or knocked off; and as the protecting wires are very near to the lamp bulb, they cause almost no obstruction to the light at the point of greatest radiation.



New Type of Protector Lamp Guard.

Generating Apparatus for Glasgow.

Bids have been invited by the electricity department of the Glasgow (Scotland) Corporation for two 3,000-kilowatt turbo-alternators, for its Port Dundas generating station, and a double-current generator of 1,400 kilowatts for the generating station at St. Andrew's Cross. Following are some of the particulars required of this machinery, as given in the London *Electrician*:

It is left to the option of the bidder whether the turbines be vertical or horizontal, provided they are arranged for direct-coupling to the three-phase alternators. Superheated steam at a pressure of 190 pounds per square inch, superheated at 550 degrees Fahrenheit, will be supplied at the engine-stop valves, and the engines are to run condensing with a twenty-seven and one-half inch vacuum. The ability to carry an overload of twenty-five per cent for two hours, and fifty per cent for thirty minutes at normal speed, is specified. The speed of the combination may be fixed by the makers. Easy accessibility to the blades and bearings is made a point. As the turbo-generators will run in parallel with the existing reciprocating engine, the maximum permissible variation in angular velocity is one-quarter per cent. They are to govern within one and one-half per cent above, and one and one-half per cent below the normal speed from no load to maximum overload. Forced lubrication is suggested.

Each turbine is to have its own condenser, and the circulating pumps and the air pumps will be driven by shunt motors.

The three-phase generators are to be of the revolving field type, developing 3,000 kilowatts at 6,700 volts, twenty-five cycles per second. At full load, with a ninety-three per cent power-factor, they must be capable of running continuously for thirty-six hours with a rise in temperature not exceeding seventy degrees Fahrenheit. Cast-steel slip rings and former-wound armature coils in micanite tubes are specified. Inherent regulation is to be such that the rise in pressure does not exceed eight per cent when the full load is thrown off. The bidder is required to state the efficiency of the generators under various conditions of load.

The double-current generator is to be capable of giving its total output of 1,400 kilowatts from the continuous-current side, or part from each, and, if necessary, for thirty hours at a stretch. It is to supply continuous current at 520 and 600 volts, and three-phase alternating current at from 318 to 367 volts, at a frequency of twenty-five cycles per second. Both armature and field coils are to be former-wound, and the temperature at any part of the dynamo must not exceed seventy degrees Fahrenheit above that of the surrounding atmosphere after a run of thirty-six hours at full load.

Localized Wireless Telegraphy.

The Italian maritime authorities have been making experiments with Alessandro Artom's method of localizing or sending wireless messages in a determinate direction, with reported success. It is also stated that this system will be used by Marconi in communicating from Italy to Argentine, for which a station is now being built at Pisa.

Artom's method of localizing consists essentially in employing circularly or elliptically polarized Hertzian waves which can be transmitted through space in a predeterminate direction. Electromagnetic waves may be polarized in this way by combining two sets of waves polarized in planes at right angles to each other. They may also be obtained by passing ordinary waves through prisms of wood or metal grids, although this plan involves a serious loss of energy through absorption. Artom uses the first method in his system. He produces two oscillatory charges of different phase and of different directions, by means of three or four spark balls. In the circuit containing the induction coil producing the sparks there is a Wehnelt interrupter. The terminals of the secondary are connected as usual to a pair of spark balls, but there is a third ball placed so as to form a triangle with the other two, and this is connected through an inductance or a condenser to one terminal of the secondary circuit. The balls are arranged as the vertices of a right-angled triangle. The aerial may be connected directly through a transformer with the third or central ball. Three or four aerials may be used, and they can be vertical or else placed in a given direction. The receiving aerial may be a large circular wire connected at two points to the coherer. This system is said to allow the height of the aerials to be reduced and to aid in syntonization.

A New Train-Lighting System.

A train-lighting system, invented by Messrs. H. Weston and C. J. Sewell, of Perth, Ontario, is described in the current issue of the Canadian *Electrical News*. The dynamo was mounted on the car truck, and driven by means of a friction pulley on the car axle. The dynamo pulley is held in contact with the driving pulley by means of compressed air, which is controlled by a pneumatic governor, self-regulated by the voltage of the generator. When the speed of the car exceeds that necessary to give the required voltage, slipping takes place between the two friction wheels. The dynamo is fitted with a pole-changer, and the car carries a storage battery and the usual equipment of lamps.

Canadian Commission to Investigate Electric Smelting Abroad.

It is reported that the ministry of the interior of Canada contemplates sending a commissioner to Europe to enquire into the electric smelting of iron ore. In Ontario and Quebec there are enormous deposits of iron ore which can not be developed at present, owing to the cost of fuel for smelting; but there is ample water power. Electric smelting plants are now being worked in France, Sweden and Italy. The commission consists of Dr. Haanel, superintendent of mines; Mr. Thomas Cota and Mr. C. E. Brown.

Meeting of Cincinnati Section of the American Institute of Electrical Engineers.

The Cincinnati section of the American Institute of Electrical Engineers held its first annual meeting at the Grand Hotel on the evening of January 18. The business meeting was preceded by a dinner in which forty members, associates and guests participated. The following officers were appointed: chairman, Mr. B. A. Behrend, chief engineer Bullock Electric Manufacturing Company; vice-chairman, Mr. J. Hendrick Hallberg, general superintendent Cincinnati Gas and Electric Company; secretary and treasurer, Mr. Louis E. Bogen, civil and electrical engineer Bullock Electric Manufacturing Company, late professor electrical engineering University of Cincinnati.

After the business meeting the chairman introduced Dr. Louis Trenchard More, professor of physics at the University of Cincinnati, who delivered an instructive and interesting talk on "Radium," exhibiting several photographs taken with radium and also a specimen of radium chloride. The lecture was followed by a general discussion on the new ideas in molecular physics and the great scientific importance of radium in such questions as the age of the earth and the revision of our views of the molecular theory of matter.

The local chapter has been started with energy and enthusiasm, and the management is arranging with able and representative engineers to lecture before its members.

Speed Variation of Shunt Motors.

To the Editor of the Electrical Review:

I have read with much interest your editorial in your issue of the second of January, 1904, on "Speed Variation of Shunt Motors." It was instructive, but why omit any mention of the most satisfactory way of all to do this, the method used by the Stow Manufacturing Company to vary the speed of its motors?

This method of speed control, which seems to have been entirely overlooked, appears to me to be the only method which most nearly fulfils the requirements of variable electric speed control.

It may be stated generally that the best method of speed control is that one which gives the widest range of speed change at the highest efficiency with the greatest simplicity of mechanism and at the least first cost.

All of the methods mentioned fail to meet these requirements in one or more particulars. Particularly is this so as regards efficiency and simplicity.

As you state, "The speed of the motor is determined by three factors—the number of armature conductors, the strength of the magnetic field and the voltage applied to the armature; the speed may be varied by changing any one, or any combination of the three."

The method of speed regulation to which I desire to call attention is a form of field regulation, but not in the sense in which this is generally understood.

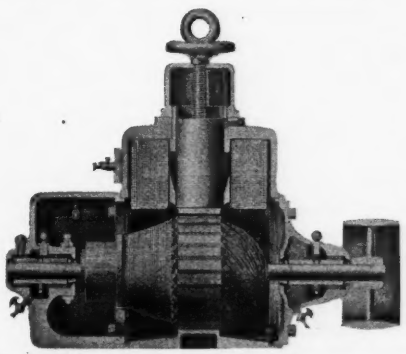
The accepted method of field regulation, and one of the methods of variable speed control most used, consists in varying the resistance of the field magnet windings by the introduction into or withdrawal from the field circuit of more or less of a highly resistant wire or other conductive material, and by so doing varying the strength of the magnetizing current and so the strength of the magnetic field.

This method is limited in range of speed variation and not of the highest efficiency, although simple in form and of low first cost. Only about forty per cent advance in speed is permissible before the field strength becomes so weak and the sparking at the commutator so great that the motor is in danger of being seriously injured or destroyed. The power output of the motor is also very materially reduced as the field is weakened. This method is also step by step and not gradual in its operation.

There is another way in which the strength of the magnetic field can be varied which is almost entirely free from all these objections. Quite a large range of speed variation, from sixty-five per cent to 120 or 130 per cent advance in speed being attainable, at the highest efficiency at all rates from the lowest to the highest speeds, in a very simple manner and at a low first cost. The motor gives a constant brake horse-power at all speeds, there is no sparking at the commutator at any speed and the method is so gradual and even in its operation that any speed from the lowest to the highest, to a fraction of a revolution, can be obtained as desired.

I refer to the method of changing the reluctance of the magnetic circuit by increasing or diminishing the amount of magnetizable material in this circuit, and so increasing or diminishing the strength of the magnetic field, the magnetizing current remaining constant at all times. The Stow multi-speed motor is an example of this method and the way in which this is accomplished is shown in the accompanying cut, which represents a sectional view of one of these motors and which conveys a clear idea of the construction of this motor.

The motor shown is of the shunt type and does not differ materially in its make-up from other motors of this type except as regards its polar construction. As shown in the illustration the upper pole is composed of a pole shoe of common form, integrally connected with a cylindrical shell over which the magnetizing coil is wound, and within which is a solid core of high permeability and of a cross-section relatively large as compared with the conducting area of the enclosing shell.



Shunt Motor, with Speed Variation by Changing Reluctance of Magnetic Circuit, with Movable Field-Pole Core.

By means of a hand wheel this inner core or "plunger" is adjustable in a direction radial to the centre of the armature, and is so proportioned that a slight variation in its position within the magnetized shell produces a very considerable difference in the reluctance of the magnetic circuit of which the plunger forms a part.

When the plunger is adjusted so that its inner end comes in contact with the pole shoe, the magnetic circuit is most complete and of a minimum reluctance, and, since the magneto-motive force of the field coil remains constant, the volume of magnetic flux becomes a maximum and the speed minimum, or normal. As the plunger is being drawn away from contact with the pole shoe a column of air is interposed which gradually increases the reluctance of the magnetic circuit as long as the plunger continues to be withdrawn. When the plunger reaches the limit of its outward motion the reluctance of the magnetic circuit, and hence the speed, becomes maximum.

It will be seen that the air-gap between the polar faces and the armature always remains fixed and constant, the air-gap inside the pole being the one which is varied, and that the design of the pole-pieces and plunger is such that as the volume of effective magnetism is diminished by the outward movement of the plunger, the remaining magnetic flux is forced more and more in the direction of the pole tips, thus furnishing a magnetic field at all times of sufficient intensity to ensure sparkless commutation.

To those familiar with the action of field-regulated shunt motors of ordinary type a variation in speed of 100 per cent by a corresponding variation of the magnetic flux would seem impossible of realization on account of the difficulty of securing sparkless commutation when the field strength of the motor is so abnormally reduced, but by the construction shown these objections are overcome, and the motor operates sparklessly under very wide variations of speed.

In regard to the fineness of speed adjustment, it is evident from the construction of the machine that there is no speed between maximum and minimum which can not be obtained by an appropriate adjustment of the hand wheel. It should be understood that while the motor carries its full load sparklessly, at any speed within its range at practically maximum efficiency, it will also carry any lesser load with a consumption of power corresponding with the actual work done. As the speed regulation is effected solely by varying the reluctance of the magnetic circuit no controller or rheostat or resistance of any kind is used in the regulation of the speed, all electrical circuits and connections remaining unchanged through the entire range of speed.

This method of variable speed control is susceptible of other arrangements and variations, but the principle involved, that of varying the reluctance of the magnetic circuit by varying the amount of magnetizable material in such a circuit gives a very wide range of speed change, at high efficiency, in a very simple manner and at low first cost; and also enables the motor to carry its full load without sparking, at any desired speed within its range, with an efficiency practically as high at one speed as at any other, and this without the use of any controller or rheostat whatever. It would therefore seem that this method is one which most nearly fulfils all the requirements of variable electric speed control.

E. R. Knowles.

New York, January 16.

[If our correspondent had read more carefully the editorial to which he takes exception, he would have seen that the method of speed control by varying the reluctance of the magnetic circuit was mentioned. He would also have noticed that no comparison of various methods of controlling shunt motors was made. We merely desired to call attention to the statement of a well-known designer, that the limitations of speed control by varying the shunt field current, which are accepted by others besides our correspondent, do not hold if a proper design is adopted.—Ed.]

CURRENT ELECTRICAL NEWS

DOMESTIC AND EXPORT.

ANOTHER DISCOVERY OF RADIUM-BEARING EARTH—It is reported from New Orleans that a discovery of radium-bearing earth has been made in the Llano gold and coal fields, 115 miles north of New Orleans. Rumors of the discovery of radium at this place have been persistent for some time, and it is now stated that a party of scientists who visited the mine to investigate the report have verified these.

ELECTRIC RAILWAY COMBINATION IN CALIFORNIA—Official announcement has been made that the Los Angeles Interurban Railway Company has acquired the properties of the California-Pacific Railway Company, the Los Angeles Traction Company and the Los Angeles & Glendale Electric Railway Company. Mr. S. B. McLenegan has been appointed superintendent of the absorbing corporation, in charge of operation. The directors of the new company are Henry E. Huntington, Howard E. Huntington, George S. Patton, George E. Pillsbury, Epes Randolph, S. C. Baxter and John D. Bicknell.

NEW YORK CENTRAL TO HAVE HIGH-SPEED ELECTRIC LOCOMOTIVES—A party of railway officers and electrical experts, with several officers of the General Electric Company, Schenectady, N. Y., inspected some of the apparatus which is being prepared for use at the terminal of the New York Central Railroad. It is stated that experiments are to be made upon a private track between Schenectady and Amsterdam, N. Y., with the object of attaining very high speeds. It is believed that the ultimate object of the tests is to secure electric engines which will be capable of maintaining a speed of 125 miles an hour, or more.

INTERNATIONAL EXCHANGE OF RIGHTS BETWEEN ELECTRIC COMPANIES—At a meeting held in Berlin, Germany, on January 20, of the directors of the Allgemeine Electrical Company, of Berlin, it was announced that a new company for the manufacture of steam turbines had been formed, and that the Allgemeine company had acquired from the General Electric Company, of Schenectady, N. Y., the patent rights to the Curtis turbine, while the General Electric Company had obtained from the Allgemeine the rights to the inventions of Professors Riedler and Stumpf, of the Technical College, of Charlottenburg. These two companies are to unite to supply capital for the Berlin Steam Turbine Company, which is the name of the new concern, the capital of which is stated to be $1,250,000. It is further stated that, working in connection with the European interests of the Thomson-Houston Electric Company, the General Electric Company and the Allgemeine company are to establish an Italian turbine company, with a capital of $1,200,000.

FINANCIERS MAKE A TRIP THROUGH THE NEW YORK SUBWAY—A party of financiers was taken through the New York subway last week, as the guests of Messrs. Belmont, McDonald and Freedman. The party was conveyed on hand cars which were worked by some of the laborers, and rode from the City Hall to 104th street. On the first car, which was in charge of Mr. August Belmont, were Jacob H. Schiff, J. W. Alexander, Robert Beacon, A. J. Cassett, Frederic Cromwell and James H. Hyde. The second car, in charge of Mr. John B. McDonald, carried Valentine P. Snyder, George J. Gould, James Henry Smith, Cornelius Vanderbilt, John D. Rockefeller, Jr., and Alfred Skitt. On the third car, in charge of Mr. Perry Belmont, were Robert H. McCurdy, Charles M. Jacobs, Andrew Freedman, Clarence H. Mackay, James Speyer, William Barclay Parsons, the chief engineer of the subway, and George Wickersham. The fourth car passengers were George W. Young, DeLancey Nicoll, Elliott Gregory, John F. O'Rourke, Samuel Rea and S. F. Curtis. It was noted that considerable progress had been made all along the line, and this was particularly true in the illumination of the tunnel, which was well lighted with gas and electricity.

A NEW TRAFFIC PROBLEM FOR BROOKLYN—The American Railway Traffic Association, of Brooklyn, N. Y., which was incorporated at Albany last week, is a new company which will carry out a long-contemplated idea of using the Brooklyn Rapid Transit Company's lines for the transportation of freight and the handling of ashes and garbage for the city. It is understood that practically all of the $1,000,000 capital stock of the traffic association is held by the Brooklyn Rapid Transit Company. Most of the work of transporting freight and refuse will be done over the Brooklyn Rapid Transit lines at night, when the passenger traffic is lightest. The company has already on hand a large number of new cars especially constructed for this business. It has not yet been determined when operations will begin. The contract the new company has made with the Brooklyn Rapid Transit Company for the operation of its freight cars and dumping cars over the Brooklyn Rapid Transit lines will give to the company an additional income for a period when there has been practically no traffic. Plans are also under way to utilize the tracks of both the Brooklyn Rapid Transit Company and of the New York City Railway Company for cleaning the streets and removing snow from all of the thoroughfares occupied by the railroad tracks.

OBITUARY NOTICES.

MR. W. O. GARRISON, whose death was noted in last week's issue of the ELECTRICAL REVIEW, was born in St. Louis, Mo., December 14, 1861. He was for many years a member of the firm of Messrs. D. E. Garrison & Company, western agents of the Illinois Steel Company, and dealers in general railway supplies. Early in the 90's he assisted in organizing the St. Louis Radiator Manufacturing Company, and was president and general manager of that company until 1898, when the company consolidated with the American Radiator Company. Mr. Garrison was widely known in the electrical field, and had been officially identified with the Columbia Incandescent Lamp Company for thirteen years, being president of that company at the time of his death, on Sunday evening, January 17, from heart failure.

DR. FRIEDRICH VON HEFNER-ALTENECK, one of the most distinguished electrical engineers of Germany, died on January 7 from an apoplectic stroke. Dr. von Hefner-Alteneck was born April 27, 1845, at Aschaffenburg, in the kingdom of Bavaria. He was a son of Dr. J. H. von Hefner-Alteneck, the archæologist. His education was obtained at the polytechnic schools at Munich and Zurich, followed by one year devoted to practical work in mechanical optical establishments in Munich. In 1867 he entered the shop of Siemens & Halske as a workman, but was soon transferred to the engineering department, and later was raised to the directorship. In this capacity he originated many of the inventions which have emanated from the firm of Siemens & Halske. Some of his early inventions were improvements in telegraphic apparatus. In 1870 he invented the drum armature, by which the disadvantages of the Siemens shuttle armature and the Gramme ring were avoided. In 1877 he invented his alternating-current generator. In 1876 he adopted the arrangement of end-connections for drum armature windings in two planes, which avoids the reciprocal crossing of many coils. Another important invention is a differential arc lamp. With this lamp and his alternator the firm of Siemens & Halske established its first electric lighting installation with a divided regulator light, in the Kaiser Gallery, in Berlin, in 1879. Herr von Hefner-Alteneck's more recent work has referred especially to the improvement of the various kinds of apparatus required for electric lighting in all its forms, and to the improvement of measuring instruments of all kinds. He invented a dynamometer which measures the force transmitted by a belt direct, and in 1883 he proposed a new unit of light, which is now almost exclusively employed in Germany, under the name of the Hefner lamp, and is frequently used in other countries. He retired from the firm of Siemens & Halske at the end of 1889, and since that time had been engaged in studying the important subject of electric regulation and research generally.

PERSONAL MENTION.

MR. PAUL W. BOSSERT has again assumed the duties of manager of the eastern district office of the Kellogg Switchboard and Supply Company at Philadelphia, after an absence of about four months.

COLONEL JOHN T. DICKINSON, heretofore general agent for the Consolidated Railway, Electric Lighting and Equipment Company, New York city, was recently made second vice-president of the company.

MR. CHARLES J. GLIDDEN lectured on the evening of January 26 before the Automobile Club of America, 753 Fifth avenue, New York city, on "13,975 Miles' Automobile Drive in Fifteen European Countries and Across the Arctic Circle."

MR. L. W. KITTMAN, who has been very successful in selling the well-known specialties manufactured by the Marshall-Sanders Company, of Boston, was married on Christmas day to Miss Crane, of Albion, Mich. He has been spending his honeymoon in the cities of Philadelphia, New York, Boston and Washington, renewing acquaintances there.

MR. ALOIS VON ISAKOVICS, secretary-treasurer of the New York section of the American Electrochemical Society, has removed to Monticello, N. Y., on the advice of his physicians. Mr. von Isakovics retains his business interests in this city, and will attend the meetings of the society and execute any business of the section entrusted to his care.

MR. E STUTZ, New York city, announces that, at the request of the secretary of the American Chemical Society, of Boston, Mass., the date of his lecture has been changed to February 25, so as to make the lecture room at the Huntington Hall available for that purpose. On February 1 Mr. Stutz will remove his office to the Wall Street Exchange Building, 43-47 Exchange place, New York city.

MR. A. C. GARRISON has succeeded to the presidency of the Columbia Incandescent Lamp Company, St. Louis, Mo. This change has necessitated his return to active service with the company, and he will now give his entire time to the business. Mr. Garrison is widely known in the incandescent lamp field, and in taking up the duties of his brother, the late Mr. W. O. Garrison, brings to the executive position a large amount of experience and practical effort.

MR. T. H. BAILEY WHIPPLE has returned to the Sawyer-Man Electric Company, to the position which he left last summer in order to take a part in the reorganization of the sales department of the Nernst Lamp Company, of Pittsburg. Mr. Whipple is an old hand in the commercial end of the electric lighting field. He was general sales agent with the Buckeye Electric Company, of Cleveland, Ohio, and held a similar position with the Jandus Electric Company, which was an offshoot of the Buckeye Electric Company, and during his connection with these two companies established most of their agencies throughout the United States. Early in 1903 Mr. Whipple went to the Sawyer-Man Electric Company, where he remained until he was called, as above noted, to the Nernst Lamp Company.

THE CANADIAN GOVERNMENT COMMISSION, recently appointed to examine into the different electrothermic processes of manufacturing steel, sailed from New York for Liverpool on January 23 on the Cunard line steamer Lucania. This committee consists of Dr. Eugene Haanel, superintendent of mines for the Canadian Government; Mr. C. E. Brown, electrical engineer; Mr. Nystrom, draughtsman, and Mr. Thomas Cota, secretary. A steel expert and a photographer will be added to the commission in England. The field of labor for the commission will be in Sweden, France and Germany. The purpose is to encourage the industry in Canada, where iron mines and waterfalls have remained undeveloped for some time. Mr. C. E. Brown, the electrical engineer of the party, is a graduate, with honors, from Ames College, Iowa. He later took up special engineering work at Cornell University, after which he was for four years with the General Electric Company, Schenectady, N. Y., as electrical engineer. For the last five years he has been electrical engineer for the Canadian General Electric Company, which position he has resigned to take part in the commission.

ELECTRICAL SECURITIES.

Compared with last week's figures, the market shows a considerable tone of improvement. The probability is that this is due to an easier feeling with regard to a war in the East. It seems evident that with the least assertion of confidence on the part of large speculators, the public is willing to reenter the stock market with considerable investment. This is only natural, as an average percentage of the speculating public already holds securities which have depreciated in value from the price which was paid for them; consequently these speculators can be relied upon to help along anything which looks like a chance for an improvement in prices. The manipulation which has been going on quite recently, and the persistent rumors that large interests are at work, has aided this movement. There is a feeling abroad that these large interests are ready to force prices up, and that it is a good time to get in and buy.

The money situation remains easy, and the possibility is that for several months there may not be any severe stringency in this direction. The prospect of an immediate decision in the Northern Securities case is attracting attention in many quarters, and the speculation as to the policies to be adopted by the two great parties is also becoming an important factor in commercial considerations.

ELECTRICAL SECURITIES FOR THE WEEK ENDING JANUARY 23.

New York:	*Closing.*
Brooklyn Rapid Transit	50¼
Consolidated Gas	195½
General Electric	177¾
Kings County Electric	184
Manhattan Elevated	145
Metropolitan Street Railway	123
New York & New Jersey Telephone	147½
Westinghouse Manufacturing Company	193

Boston:	*Closing.*
American Telephone and Telegraph	129
Edison Electric Illuminating	235
Massachusetts Electric	79½
New England Telephone	121
Western Telephone and Telegraph preferred.	82

The instrument output of the American Telephone and Telegraph Company for the month ending December 30, 1903, shows a material falling off in the gross output, the figures—88,947 instruments—comparing with 96,963 for the month of November. The number of instruments returned during the month was 39,678, the largest returns reported since the month of October. The net output, 49,269, compares with 64,566 for November. The gross output for the year was 1,109,888, and the returned 480,691, leaving a net output of 629,197, as compared with 573,194 for the preceding year. The total number of instruments now outstanding is 3,779,517.

The Western Telephone and Telegraph Company has declared a regular semi-annual dividend of $2 per share on the preferred stock, payable February 1 to stockholders of record January 22.

Philadelphia:	*Closing.*
Electric Company of America	8¼
Electric Storage Battery common	60
Electric Storage Battery preferred	60
Philadelphia Electric	6¼
Union Traction	47⅛
United Gas Improvement	88½

Chicago:	*Closing.*
Chicago Telephone	123
Chicago Edison	150
Metropolitan Elevated preferred	52
National Carbon common	26½
National Carbon preferred	95
Union Traction common	5¼
Union Traction preferred	30½

National Carbon directors have declared the regular quarterly dividend of 1¾ per cent on the preferred stock, payable February 15. Books close February 2 and reopen February 16.

At the meeting of the stockholders of the Chicago Telephone Company, held January 20, the authorized capital stock was increased to $20,000,000, from $15,000,000. The issue of the new $5,000,000 will be spread over possibly three years. For the year ended December 31, 1903, the gross earnings of the company were $5,534,590, and the expenses, $4,113,246, leaving net earnings of $1,421,344. $1,274,835 was paid in dividends, leaving a surplus of $146,509, as compared with $127,278 for 1902. The assets of the company show an increase of $2,348,475, making a total of $15,251,354. During the year $1,428,320 was invested in a new plant, and there was an increase of $2,007,000 in stock issue.

ELECTRIC LIGHTING.

GROVE CITY, PA.—Application has been made by E. J. Fithian and John Carruthers for an electric light franchise.

AURORA, IND.—The city council has made a contract with the Aurora Gas Company to temporarily light the city by electricity.

ATLANTA, GA.—It is stated that the town of Conyers will erect a municipal electric light plant, to cost $10,000, the money to be raised by a bond issue.

PORTAGE, WIS.—It is stated that the Chicago, Milwaukee & St. Paul road will install an electric light plant and pumping station of its own in this city.

LA PORTE, IND.—The La Porte Electric Company is installing a new 3,300-volt dynamo in its Washington street station, to meet the growing demand for lighting.

BALLARD, WASH.—Work has begun on the new power-house for the Ballard Electric Company, and as soon as the excavating is finished, the work of the building will begin.

PARKERSBURG, W. VA.—The board of affairs has appointed a special committee to investigate and report on the probable cost of constructing an electric lighting plant to furnish light for the city building.

SHELL LAKE, WIS.—At a special town meeting the ordinance to secure $10,000 from the state fund for the purpose of erecting a power, water and light plant was carried by a majority of 31 out of 241 votes cast.

HOOSICK FALLS, N. Y.—The town board has awarded the street lighting contract to the Hoosick Falls Electric Company. It is to run for three years, and the town is to pay at the rate of $60 per lamp per annum.

AUSTIN, TEX.—The city water and light commission contemplates increasing the equipment of the light and power plant by the purchase of a turbine engine. The proposed improvement will cost about $20,000.

LITTLE ROCK, ARK.—J. T. Smith, of Quincy, Ill., and Edward Ryan, of Chicago, are said to be interested in a plan to establish a $75,000 electric light and ice plant at Cotter, on the White River branch of the Iron Mountain road.

LOUISVILLE, KY.—It is stated that the Weissinger tobacco plant in this city is to be converted into one of the largest power supply houses in the United States. Plans have already been formulated, and work on the new plant will be begun within the next few weeks.

ROCHESTER, N. Y.—The New Light, Heat and Power Company has elected the following officers: president, Frank F. Garlock; secretary and treasurer, Abram Garlock. The above and Daniel P. Smith, Byron C. Thomas, S. F. Price and Hanson A. Gardner constitute the board of directors.

PITTSFIELD, MASS.—The Boston & Albany Railroad Company is said to be considering the advisability of installing a private electric light plant in the Chatham, N. Y., station. Besides lighting the building, the lines would be extended to the freight offices, freight house, switch and gate towers, etc.

BUFFALO, N. Y.—The town of Waddington at a special election voted to sell its municipal electric light plant, water power and rights to a Canadian company, for $3,500, the amount which remains unpaid on the plant. The municipal operation of the concern is said not to have proved satisfactory.

EL PASO, TEX.—An organization has been perfected in Douglas, Ariz., for the establishing there of another electric light and ice plant. The stockholders are composed of the following Douglas people: F. S. Douglas, W. G. McDonald, A. S. Pierce, C. J. Lachance, D. A. Richardson and others. The capital stock is to be $60,000.

BALDWINSVILLE, N. Y.—At the regular meeting of the village board of trustees the Seneca River Power Company was awarded a five-year contract for street lighting. The contract calls for twenty-four arc lamps of a nominal 2,000 candle-power, consuming 450 watts at the arc, at $90 each per year, and seventy-five incandescent lamps at $16 per year, making a total cost per year of $3,360. The system is to be in operation by April 1.

DULUTH, MINN.—At the annual meeting of the Great Northern Power Company there was but one change made in the board of directors, the name of M. H. Alworth being added to the list, he taking the place of A. B. Wolvin, resigned. The board of directors is now as follows: C. A. Duncan, Alex McDougal, A. M. Marshall, M. H. Alworth, F. A. Cokefair, F. A. Patrick and George M. Rittenhouse. The board elected these officers: president, C. A. Duncan; vice-president, F. A. Cokefair; treasurer, George M. Rittenhouse, and secretary-manager, C. C. Cokefair.

ANNAPOLIS, MD.—Joseph S. Kemp, George M. Bunting, Peter H. Cleaver, Philip M. Groves and William Sterling Evans have incorporated the Octarora Water and Power Company. It is designed to harness the water power of Octarora creek, which has its source in Pennsylvania and empties into the Susquehanna just north of Port Deposit. While the stream is not large, it has a very heavy fall, and this is sufficient to produce great power, which is to be converted into electricity. The company has already made extensive purchases of land and water rights, and the scheme is said to be a large one.

ELECTRIC RAILWAYS.

PORTLAND, ME.—The Portland Railway Company has purchased a site on which it will erect a power station which will be almost a duplicate of its Deering Point power plant.

DAYTON, OHIO—The contract for the construction of the Dayton & Kenton Traction Company's line as far as Degraff has been awarded. The work is to begin by April 1, and the line is to be in operation within a year. The third rail system will be used.

SPRINGFIELD, ILL.—A party of engineers is making a new survey for the electric line from Riverton to Decatur. According to the new survey the line will run through Mechanicsburg, leaving out Dawson, Buffalo and Lanesville. It will leave the Wabash Railroad at Riverton and touch it again at Illiopolis.

SOUTH BEND, IND.—The Indiana Western Railway Company, which proposes to build an electric line west from this city through New Carlisle, has deposited a $500 forfeiture bond with that town. Under the bond the company proposes to have cars running through the main street of New Carlisle by November 16, 1904.

GOSHEN, IND.—It is just announced that the Syracuse Cement Company, of Syracuse, Ind., has plans well under way for the construction of an electric railway from Syracuse to New Paris, a distance of six miles, and that at a meeting of the cement company's directors last fall an appropriation of $150,000 was made for the purpose.

RICHVIEW, ILL.—The following towns have granted franchises to the Southern Illinois Electric Railway Company, between Mt. Vernon and St. Louis: Salem, Odin, Sandoval, Centralia, Irvington, Hoyleton, Minden, Mascoutah, Okawville, New Memphis and Belleville. It is stated that construction work will be commenced shortly. The main power-house is to be erected at Irvington.

DES MOINES, IOWA—The Ottumwa Traction and Light Company has filed an amendment to its articles of incorporation in the office of the secretary of state increasing its capital stock to $250,000. It is understood the new capital will be used in extending the street car system of the town. James H. Merrill is president of the company, Jacob B. Sax, secretary, and Jarrett W. Garner, treasurer.

LOGANSPORT, IND.—The large power-house at Anderson, from which power is to be supplied to the Logansport lines, has been completed. The plant, which is one of the finest in the country, contains five 2,000-horse-power engines, whose capacity may be pushed to 2,500 in case of emergency. The plant will furnish sufficient power for operating every line owned by the company.

GREENSBURG, PA.—The Greensburg & West Newton Street Railway Company, which has projected a line from the southwestern end of the county to Greensburg, will begin work of construction in the spring. Here connection will be made with the Pittsburg, McKeesport & Greensburg line. The line will open up a rich mining district, touching Grapeville, Adamsburg, Arona, Madison and West Newton.

READING, PA.—At a meeting of the stockholders of the East Reading Electric Railway Company these directors were elected: A. J. Brumbach, William R. McIlvain, J. A. Strohecker, George W. Bard, J. G. Leinbach, Frank P. Esterly, John H. Printz and William McIlvain. A. J. Brumbach was chosen president; J. G. Leinbach, vice-president; George W. Bard, treasurer, and William McIlvain, secretary.

CHAMBERSBURG, PA.—At the annual meeting of the stockholders of the Chambersburg & Gettysburg Electric Railway P. C. Evans, of Easton, was chosen president and the following directors: Horace L. Magee, of Easton; H. L. Buxton, Keyser, W. Va.; George R. Halterman, Bethlehem; Colonel Thomas B. Davis, of Keyser, W. Va.; Dr. A. C. Herman, Lansdale, Pa.; A. F. Gerstell, Easton, Pa.; Stephen S. Emery, Allentown, Pa.; P. C. Evans, Easton, Pa.

NORFOLK, VA.—At the annual meeting of the board of directors of the Chesapeake Transit Company, the following officers were elected: A. H. Flint, New York, president; James C. Chaplin, Pittsburg, vice-president; John T. Bacon, of New York, treasurer; C. T. Grandmont, New York, secretary; J. E. Cole, Norfolk, general counsel. The double-tracking of the line to Cape Henry and Virginia Beach was discussed, and it is stated that work will begin shortly.

GOSHEN, IND.—The Winona, Warsaw & Goshen Railway Company, which proposes to build an electric line from Winona through Milford Junction and Milford, in Kosciusko County, and Nappanee, in Elkhart County, terminating in Goshen, has been incorporated. The road will follow the right of way of the Cincinnati, Wabash & Michigan Railroad. The company is capitalized at $10,000. The incorporators are: James B. Hanna, Francis C. McMillin, Samuel G. Morris, Christian Girl and L. A. Collins. The headquarters of the company will be at Goshen.

ST. LOUIS, MO.—Articles of incorporation of the St. Louis-Granite City & Alton Traction Company were filed in the office of the secretary of state in Springfield, Ill., recently. The offices of the company are to be located at Granite City and the capital stock is given as $150,000. The proposed line is to be constructed from East St. Louis, St. Clair County, to Alton and Edwardsville, in Madison County. The incorporators and first board of directors are W. M. Warnock and Harrison Barco, of Edwardsville; George Miller, of Venice; David R. Francis and F. E. Allen, of St. Louis.

INDIANAPOLIS, IND.—The Indianapolis, Danville & Rockville Traction Company has increased its capital stock from $100,000 to $700,000. The increase of $600,000 is made as consideration in the construction and equipment of the company's new road from Indianapolis to Danville. A large increase in capital stock of the Fort Wayne & Southwestern Railway Company has also been recorded by the secretary of state. The capital stock of $1,875,000 is increased to $2,000,000, the increase being made in accordance with a resolution passed at the regular meeting of the stockholders and directors held at the company's office in Indianapolis January 4. The increased capital will be used to further the company's plan of extending its lines.

YORK, PA.—By the completion of two electric railways, the corporations of which have recently been merged, York will be directly connected with Harrisburg and many towns in the Cumberland valley. York capitalists are interested in the corporations. The lines are the Star Street Railway Company and the Harrisburg & Lewisberry Street Railway Company, and the name of the new company after the completion of the merger is the Steelton, New Cumberland & Mechanicsburg Street Passenger Railway Company. One of the new lines will run from Mechanicsburg to Bowmansdale and through the streets of Mechanicsburg; also from New Cumberland to Lewisberry and Silver Lake, with an extension from New Cumberland over the bridge to be erected across the Susquehanna river from New Cumberland to Steelton to connect with the East Harrisburg Traction Company in Steelton; also extending from Lewisberry to Lisburn and Bishop's park. The capital is $200,000, and the officers are as follows: president, M. P. Hillyer, New York city; vice-president, J. E. Philips, York; treasurer, Jacob H. Foreman, Carlisle; secretary, Harry Hertzler, Carlisle. Directors: Harry Hertzler, Jacob H. Foreman, Samuel Hertzler, Carlisle; H. W. Smith, Mechanicsburg; J. W. Andrews, Brooklyn; R. N. Stonesifer, Lewisberry; C. B. Miller, Harrisburg.

NEW INCORPORATIONS.

RALEIGH, N. C.—Randleman Telephone Company. $5,000.

LITTLE ROCK, ARK.—Searcy Power Company. $150,000.

DAYTON, OHIO—The Kirtland Telephone Company. $2,500.

FRANKFORT, KY.—Kirksville Telephone Company. $7,500.

NEWPORT, N. H.—The Newport Telephone Company. $2,000.

RICHMOND, VA.—East Tennessee Telephone Company. $10,000.

JACKSON, MICH.—Pleasant Lake Telephone Company. $2,000.

FRONT ROYAL, VA.—The Royal Telephone Company. $5,000.

PLATTSBURG, N. Y.—The Beekmantown Telephone Company. $1,000.

HARRISBURG, PA.—People's Light, Heat and Power Company. $10,000.

INDIANAPOLIS, IND.—The Turman Township Telephone Company. $2,250.

BUFFALO, N. Y.—The Globe Power Company. Increased from $200,000 to $500,000.

UNIONTOWN, PA.—The Dunbar Electric Company; $5,000. West Fayette Electric Company; $5,000.

INDIANAPOLIS, IND.—Vincennes Citizens' Street Railway Company. Increased from $15,000 to $100,000.

GUTHRIE, OKLA.—Temple Telephone Company. $6,000. Incorporators: L. I. Hensley, D. S. Tandy and B. V. Loosemore.

NEW YORK, N. Y.—The Masonville Telephone Company. $3,500. Incorporators: D. O. Smith, L. L. Sornberger and W. E. Bogart.

LOS ANGELES, CAL.—The Dale Telephone Company. $10,000. Incorporators: H. Ames, F. A. Reed, T. B. Pierson, James J. Ellerman.

PITTSBURG, PA.—The Fairchance Electric Company. $5,000. Directors: Jacob B. Van Wagener, John F. Cochburn, Clarence W. Sheck.

CENTER POINT, IND.—Center Point Telephone Company. $5,000. Incorporators: H. F. Weber, P. L. Lanset and M. A. Campbell.

GREENSBURG, PA.—North Huntingdon Electric Company; $5,000. Hempfield Electric Company; $5,000. East Huntingdon Electric Company; $5,000.

ALBANY, N. Y.—The Wheatland Power Company. $20,000. Directors: I. W. Salyerds, of Scottsville; M. E. Lewis and H. C. Brewster, of Rochester.

DETROIT, TEX.—Detroit Electric Light and Power Company. $10,000. Incorporators: W. E. Whitner, W. T. Davis and J. R. Dillahunty, all of Detroit.

BUFFALO, N. Y.—The Wilhelm Telephone Company. $5,000. Directors: Theodore H. Meyer and Walter L. Wilhelm, of Buffalo, and Henry A. Brehm, of Baltimore.

COLUMBUS, OHIO—The Toledo-Fort Wayne Electric Railway. $100,000. Incorporators: J. M. Brown, E. E. Davis, H. C. Webster, J. F. Kindell and Walter F. Brown.

SANTA FE, N. M.—The Gallup Electric Light Company. $50,000. Incorporators: Maynard Gunsul and Herbert F. Raynolds, of Albuquerque, and Kenneth K. Scott, of Gallup.

NEW YORK, N. Y.—Nassau Electric Wiring Company. To manufacture electricity for lighting, etc. $1,000. Incorporators: John J. Mathews, L. B. Truslow, Great Neck; R. Stockton, New York city.

PITTSBURG, PA.—Pittsburg Heat and Power Company; $5,000; directors, Harry J. Graham, Allegheny; Alexander Black, Park J. Alexander, Pittsburg. City Light Company; $4,000; same directors.

COLUMBUS, OHIO—The Trimble & Hocking Valley Railway Company; $10,000; incorporators, C. W. Thompson, L. G. Addison, P. C. Morris, E. F. McManigal, E. M. Poston. The Vale Telephone Company; $5,000; incorporators, W. W. Scott, John Malone, John Hull, C. M. Simms and A. P. Vale.

INDUSTRIAL ITEMS.

THE ELECTRIC TESTING LABORATORIES is the new name of the Lamp Testing Bureau. The address of the company has been changed to 14 and 16 East End avenue, New York city.

THE JEFFREY MANUFACTURING COMPANY, Columbus, Ohio, through its connection with the Ohio Malleable Iron Company, is now in the field soliciting orders for high-grade malleable castings.

THE POWER AND MINING MACHINERY COMPANY, New York city, N. Y., is sending out a handsome catalogue treating on gas engines which it manufactures. This catalogue will be sent on request.

THE AMERICAN STEAM PUMP COMPANY, Battle Creek, Mich., illustrates and describes in a catalogue which it is distributing, the "Marsh" boiler feed pump. Catalogue will be sent on request.

THE ATLAS CAR AND MANUFACTURING COMPANY, Cleveland, Ohio, has issued a catalogue in which it illustrates and describes mine and ore cars which it manufactures. Catalogue will be sent on request.

THE SWEDISH-AMERICAN TELEPHONE COMPANY, Chicago, Ill., is sending out a catalogue showing telephones and switchboards for central energy and magneto systems which it manufactures. This will be sent on request.

THE CENTRAL ELECTRIC COMPANY, Chicago, Ill., reports an exceedingly good business on Columbia incandescent lamps, for which it is sales agent. The company announces that it will now be able to supply miniature lamps of the Columbia brand.

THE EDISON STORAGE BATTERY COMPANY, Orange, N. J., illustrates and describes in an attractive catalogue the new "Edison" storage battery. This catalogue will be found interesting to those studying the storage battery question, and will be sent on request.

THE JEFFREY MANUFACTURING COMPANY, Columbus, Ohio, is sending out a pamphlet illustrating and describing the "Jeffrey" grab buckets. There is also shown illustrations of "Jeffrey" conveyors and "Jeffrey" dredging machinery. Pamphlets will be sent on request.

THE ROBINS CONVEYING BELT COMPANY, New York city, N. Y., is sending out a very pretty souvenir showing comparative views of lower New York in the twentieth century and 250 years previous. There are also a photograph of the Flatiron Building and a photograph of the Park Row Building shown.

THE EDISON COMPANY, New York city, N. Y., has issued the January, 1904, number of the *Bulletin* of the New York Edison Company. On the front cover is shown an illustration of the new Williamsburgh bridge, on the opening night of December 19, 1903. The *Bulletin* contains numerous interesting articles and illustrations.

THE EDISON ELECTRIC ILLUMINATING COMPANY, Boston, Mass., and the Edison Storage Battery Company, Orange, N. J., describe in a pamphlet just issued, entitled, "Charging Automobiles, Public Electric Station," the test run made by the Edison company's automobile between Boston and New York and return, October 20 and 30, 1903. This pamphlet will be sent on request.

WALSH'S SONS & COMPANY, New York city, wholesale dealer in scrap iron and metals, is distributing a memorandum calendar and diary pad for 1904. This pad gives spaces in one sheet for every day in the week, and is convenient and practical for desk work. The company has on hand a strong line of engines, boilers, pumps, stacks, dynamos, motors, hangers, pulleys, shafting and other mechanical apparatus.

THE CONSOLIDATED RAILWAY ELECTRIC LIGHTING AND EQUIPMENT COMPANY, New York city, N. Y., announces that at a meeting of the board of directors held January 13 Colonel John T. Dickinson, heretofore general agent, was elected second vice-president in charge of negotiations with railway companies for the use of the Consolidated "axle light" system of electric car lighting. The company's general offices were recently moved from 100 Broadway to the Hanover Bank Building, New York city.

THE H. W. JOHNS-MANVILLE COMPANY, New York city, N. Y., has placed on the market a fireproof material called "Niagrite," which is furnished in strips from three to thirty-six inches wide, suitable for wrapping spirally on electrical cables, and is held in place with asbestos fireproof glue, thus protecting the cable from external fire and confining any internal fire. The material presents a neat and permanent finish and, it is said, is not affected by atmospheric conditions. Full particulars may be obtained by addressing the asbestos department of the company.

J. G. WHITE & COMPANY, New York city, N. Y., has the contract and is the engineer for the extension of the Monterey Electric Light and Power Company's plant and system at Monterey, Mexico. The plant will be enlarged, and the old 133-cycle 1,100-volt generators will be replaced by 2,200-volt sixty-cycle apparatus. The city arc lighting, for which this company has a contract, will also be changed from the open arc to the series enclosed alternating type. For the extension of the plant J. G. White & Company has purchased from the General Electric Company a 500-kilowatt turbine set, two 240-kilowatt revolving field alternators, two seven and one-half and twenty-five-kilowatt exciter generators, and a complete switchboard. An additional boiler has been purchased from the Babcock & Wilcox Company. Four condensing pumps, meters, transformers, fans and arc lamps are still to be purchased for the station.

THE LEEDS & NORTHRUP COMPANY, 259 North Broad street, Philadelphia, Pa., has published a complete set of catalogues descriptive of electrical testing instruments. The general catalogue, descriptive of electrical testing instruments, covers apparently everything necessary for first-class work in this line, and shows not only photographic reproductions, but essential connections, and accurately describes the use of the apparatus. Catalogue No. 4 describes standard resistances. The company has given a great deal of attention to this line of material, and the catalogue is full of good reading on this subject. Catalogue No. 380 describes portable testing sets and cable-testing apparatus. Catalogue No. 7 describes a new line of high-grade keys for electrical testing, and gives some valuable information upon the subject of contacts and joints. The Carey-Foster bridge, for accurate comparison of resistances, is described in catalogue No. 9. This apparatus is used in the company's own laboratory for all high-resistance measurements. Catalogue No. 3 describes moving-coil galvanometers. In this catalogue is taken up the wall D'Arsonval galvanometer, type H, which is a splendid instrument for general laboratory work. Catalogue No. 1 describes resistance boxes and Wheatstone bridges, and gives a number of very valuable hints as to manipulation of connections for various ratios. Catalogue No. 2 describes the standard potentiometer. This is the chief specialty of the Leeds & Northrup Company, and is guaranteed to be a remarkable instrument in every way. Catalogue No. 8 is descriptive of self-induction apparatus. This is not a new line, but the material is of great value in laboratory practice.

AUTOMOBILE NOTE.

THE ANNUAL BANQUET OF THE AUTOMOBILE CLUB OF AMERICA—The fifth annual banquet of the Automobile Club of America was held in the ballroom of the Waldorf-Astoria, New York city, on the evening of Saturday, January 23. Some 400 members and guests sat down to the tables at 7.30 o'clock. At the rear was a small model of the air-ship of Alberto Santos-Dumont, who was one of the guests of the evening. Mr. Winthrop E. Scarritt, president of the club, acted as toastmaster. Mr. Jacob H. Gallinger, United States senator from New Hampshire, opened the speeches, devoting his remarks to general automobile topics. The other speeches included "Why the United States Should Aid the Good Roads Movement," by A. C. Lattimer, and "The Value of Automobiling for Mental and Physical Health," Gage E. Tarbell. Mr. Simeon Ford gave a most interesting account of his experiences as an automobilist. Other speakers were the Hon. W. P. Brownlow, senator from Tennessee, Colonel A. A. Pope, of Boston, and James B. Hill. Among the guests of honor were Mr. Thomas A. Edison, General Nelson A. Miles, Charles J. Glidden, Colonel John Jacob Astor, State Engineer Edward A. Bond, Commodore Frederick G. Bourne, John Brisben Walker and Charles G. Gates.